POWER PLANT ENGINEERING

Established Over 30 Years

VOL. XXX CHICAGO, NOVEMBER 15, 1926 No. 22

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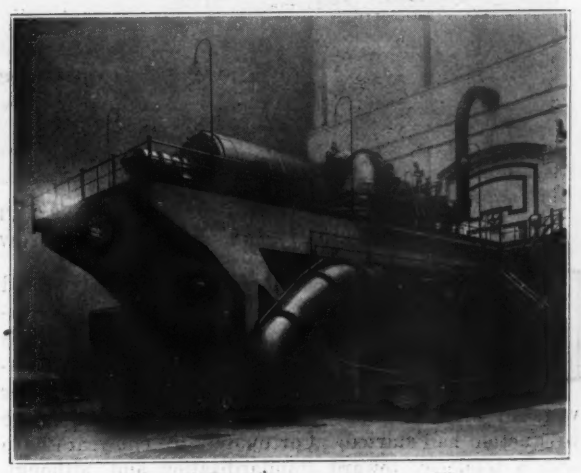


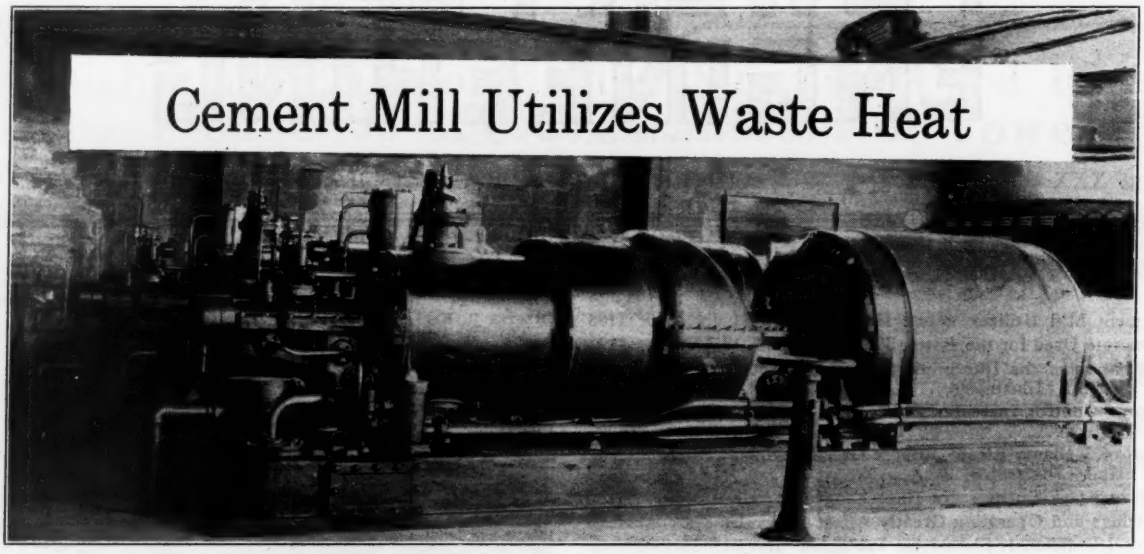
Noah's Concrete Ark

IF MR. NOAH, the genial host of our common ancestors were building the ark today, his problem would be infinitely more complex than he originally found it to be. During the war Uncle Sam built a number of monolithic concrete ships, so that there would be wood, steel and concrete construction to choose from. Something of a problem in itself without considering the seven thousand synthetic or patented building-process salesmen who would want to get in on the job.

Mr. Noah's engineering department might be dominated by the power plant engineer, in which case the result would probably be a blunt nosed scow modeled after good power plant practice, perhaps the self-same installation pictured above; the turbine on deck so as to be above high water, the condenser low enough to form a good syphon seal for the circulating water discharge pipe. Of course, the combination concrete hull-foundation would be scientifically proportioned, mixed and poured as outlined on page 1193 in order to reduce the cost, as Mr. Mellon classifies ark building as "sports" and as such subject to an amusement tax.

Can you imagine the language of a brave sailorman from our "right" and "left" hand navy while trying to beach such a tub on the Himalayas at, say, seven bells of a nice summer evening after a six months' cruise? No doubt it would be a liberal education for the land-loving biblical skipper.

Cement Mill Utilizes Waste Heat



OLDEST CEMENT MILL IN MIDWEST, ALWAYS A PIONEER IN DEVELOPMENT OF THE CEMENT INDUSTRY, NOW OPERATES MODERN WASTE HEAT POWER PLANT IN CONJUNCTION WITH NEW KILNS

FOLLOWING the introduction of the Portland cement industry to this country half a century ago, constant replacement of methods and machines formed an animated background against which the manufacturer watched his new plant become obsolete almost before production had started. Fortunately, recent years have seen a tendency toward standardization and, although further improvements are inevitable, they will probably be in the nature of refinements rather than radical departure from present practice.

Plants built in the nineties that have followed new developments and can still be classed as modern are relatively few. Among these few the Peninsular plant of the Consolidated Cement Corp. stands out as a leader in constructive development. Built at Cement City,

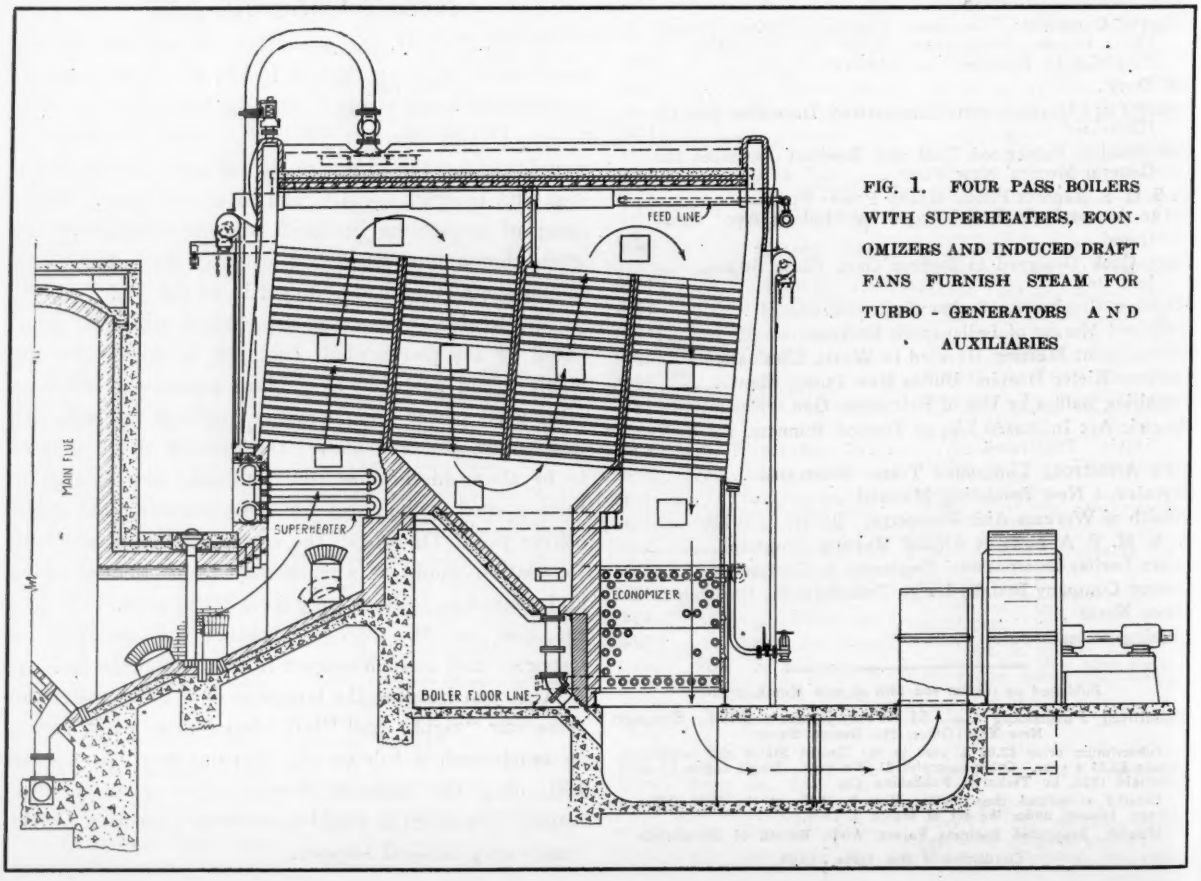


FIG. 1. FOUR PASS BOILERS WITH SUPERHEATERS, ECONOMIZERS AND INDUCED DRAFT FANS FURNISH STEAM FOR TURBO-GENERATORS AND AUXILIARIES

Mich., in 1899, by W. F. Cowham, founder of the Cowham Engineering Co., the plant, consisting of six 6 by 60-ft. kilns, was one of the first mills in the midwest section with the added distinction of being the first plant in this country, which is still operating, to use individual motor drive.

Original Motors Used Over 25 Yr.

Electric power was furnished by two Green-Wheelock cross compound engines direct connected to 25-cycle generators. When the new power plant was installed the first part of this year, 60-cycle current was substituted and necessitated the removal of several of the original 25-cycle motors, installed in 1899 and 1900, which were still in use. In 1921 a 2500-kv.a. turbo-generator was purchased to augment the output of the two engines.

During 1903 three 7 by 80-ft. kilns were added and extensive experiments carried out with a flat hearth drier for removing the moisture from the raw products before they entered the kiln. This is believed to have been the first attempt in the cement industry to use waste kiln gases. In 1915 the nine kilns were replaced by three 9 by 125-ft. kilns, to which were added 7 by 80-ft. sections, making three 205-ft. kilns which now serve as auxiliaries to the two 11 by 175-ft. kilns installed this year. Kilns are slightly inclined and are fired by powdered coal at the lower end. Slurry, pumped by centrifugal pumps to a supply tank above the kiln housing is fed to the upper end of the kilns by ferris wheel feeders driven by chain drive from the same motor as the kiln so that the feed is always proportional to the kiln speed.

Flexibility Provided by Main Flue Design

The arrangement of the kilns, kiln housing, main flue, stacks, dampers and boilers is shown in the plan, Fig. 2. An unusually flexible arrangement is provided with flues and dampers so arranged that either, both or neither boiler can be operated by either or both kilns or steam can be supplied from the auxiliary boiler when neither kiln is operating. The common flue, 7 by 22 ft., extends the width of the boiler room and is connected with the natural draft stack. This stack of monolithic concrete construction, 157 ft. high and 10 ft. in diameter at the top, also serves the auxiliary hand-fired boiler. When the hot gases exceed the steam demand a damper is opened and the excess gases bypassed to the main stack. A draft of 0.25 to 0.30 in. is maintained at the kiln housing and this is kept constant by varying the speed of the induced draft fans.

Kiln housings and flues are included in the power house proper, a steel frame structure surfaced with portland cement gunite and roofed with corrugated asbestos. The main building is 45 by 141 ft. with a wing 20 by 79 ft. on one side. Boilers, induced draft fans, switches, pumps, condenser and air compressor are located on the ground level while the operating panels, fan controllers, generators, exciters, switchboard and chief engineer's office are located on the first floor. The plant was designed by F. E. Dodge, chief engineer of the Cowham Engineering Co., and was installed under the direction of J. E. Kaminska, who is now chief engineer of the plant.

Steam at 225 lb. gage, 150 deg. F. superheat is supplied by two 900-hp. Edge Moor four-pass, vertically

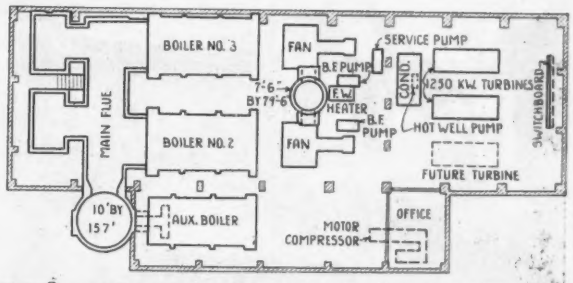


FIG. 2. BOILERS AND TURBINES ARE IN THE SAME ROOM, SEPARATED BY THE INDUCED DRAFT FANS AND STACK

baffled, water tube boilers, 20 tubes high and 17 tubes wide. The setting with flue arrangement, baffling, location of superheater and economizer elements are shown in Fig. 1. Each boiler is equipped with a 3885-sq. ft. economizer 12 tubes high and 10 wide. A 348-hp. auxiliary hand-fired boiler with shaking grates is provided for emergency operation when the plant is starting up or shutting down. This boiler uses the same tubes as the larger ones and operates on natural draft from the main stack. Each waste heat boiler has an induced draft fan discharging to a 7 ft. 6 in. by 79-ft. concrete stack. These fans are driven by 150-hp. variable speed motors with 13 point controllers so that the speed may be regulated to maintain a constant draft at the kiln housing. Both motors are 514 r.p.m., 2200-v., slip ring type with a maximum speed reduction of 50 per cent.

After leaving the superheaters steam goes through a 10-in. header and individual steam separators to the turbines as shown in Fig. 6. A 6-in. auxiliary header is used for all steam driven auxiliaries, individual auxiliary steam and various water lines being indicated on the schematic diagram, Fig. 7.

Two 3600-r.p.m., 200-lb., 150 deg. superheat, three-stage reaction type turbines drive 2300-v., three-phase,

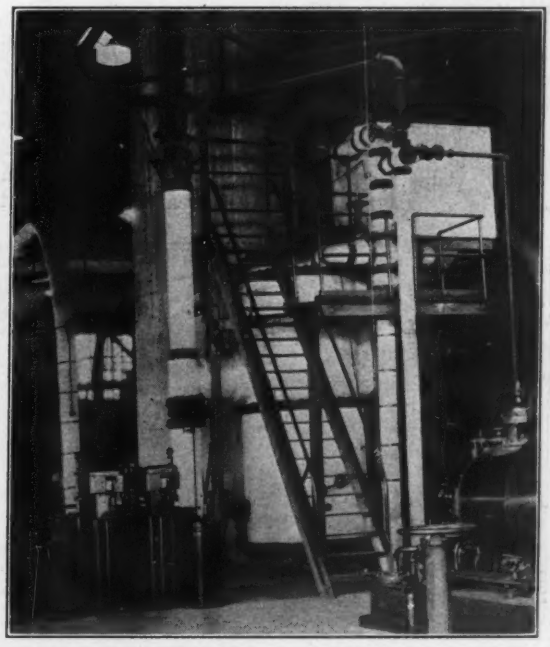


FIG. 3. BOILER FEED WATER IS METERED BY A V-NOTCH WEIR AND HEATED IN A DE-AERATING HEATER

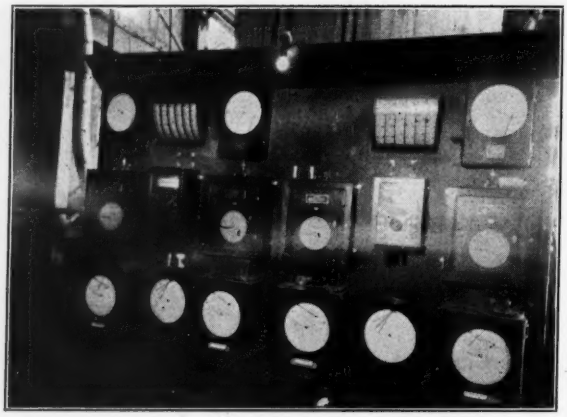


FIG. 4. EACH BOILER HAS AN INDIVIDUAL GAGE BOARD WITH NINE INSTRUMENTS

60-cycle generators rated as 1250 kw. at 80 per cent power factor. Excitation current is supplied at 125 v. by either of two exciters, a 25-kw., 3600-r.p.m., non-condensing turbine-driven unit or a 30-kw., 1750-r.p.m. motor-driven unit. An eleven panel black slate switchboard complete with instruments, synchroscope and voltage regulator is located behind the generators with switches located directly beneath on the first floor. Direct current at 250 v. for crane service in the mill is furnished by a 75-kw. motor generator set driven by a 115-hp., 440-v. motor. In general, all motors of 75 hp. and smaller are 440-v., three-phase, 60-cycle, while those above 75 hp. are 2200-v., three-phase, 60-cycle.

Hand Lance and Compressed Air Used for Blowing the Fine Abrasive Dust from Boiler Tubes

Compressed air is supplied by an 11 by 14-in. duplex air compressor close belted to a 100-hp., 700-r.p.m., 2200-v. motor. Air at 20 lb. is used for agitating the slurry tanks but the compressor is piped up in such a manner that it will supply 100 lb. air for blowing the dust off the boiler tubes. The boilers are dusted once each shift with a hand lance, the small amount of dust falling down to the ash pit and passing to the induced draft tunnel below the economizer.

Feed water is measured by a V-notch meter and heated in an 80,000-lb. deaerating heater supplied with

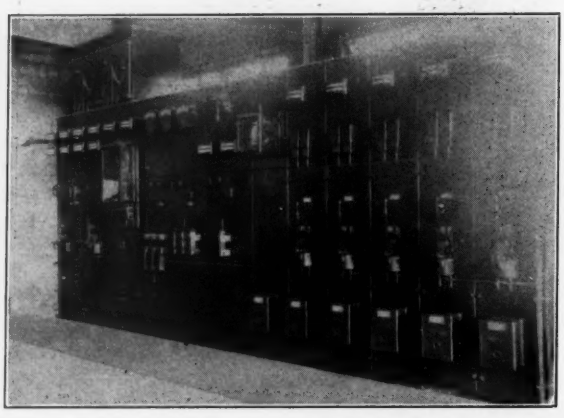


FIG. 5. ELEVEN BLACK SLATE PANELS MAKE A VERY COMPLETE SWITCHBOARD

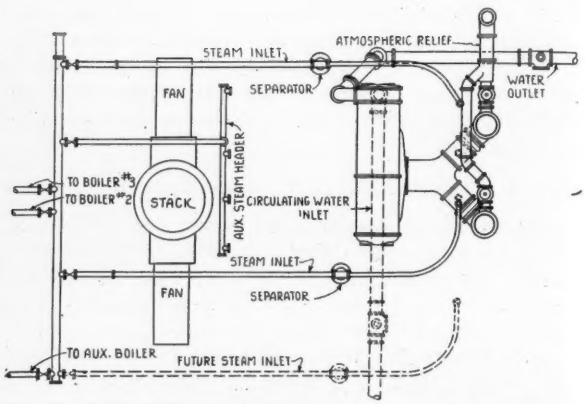


FIG. 6. BOTH TURBINES EXHAUST TO A SINGLE SURFACE CONDENSER

exhaust steam from the auxiliaries. Two 2-in., 6-stage centrifugal boiler feed pumps driven by 45-hp., 3600-r.p.m. steam turbines supply water to the boilers at a maximum rate of 150 g.p.m. each against a total head of 650 ft. Copes boiler feed regulators with compound ports are used on all boilers. Makeup runs well below 5 per cent as the heating load is small. Bleeder connections from the third stage of the turbines are provided for a vacuum heating system but it is not expected that it will be necessary to use them for some time at least.

Both turbines are served by one 6000 sq. ft. surface condenser made up of 1900 brass tubes 5/8 in. in diameter and 17 ft. long. The piping arrangement is clearly indicated in Fig. 6. Each turbine is equipped with a 12-in. atmospheric relief valve, a 30-in. expansion joint, as well as a 30-in. exhaust valve, which is not shown on the plan, Fig. 6. Although limestone and clay are now received by rail, the plant was originally designed to use marl from a nearby lake and clay from Ohio. Years of excavation formed a fair sized lake which now serves as a supply for condenser circulating water. The circulating water pump is located in a concrete pump house at the edge of this lake several hundred feet from the power house. It is a 14-in. centrifugal pump set several feet below the water level and driven by a 100-hp.,

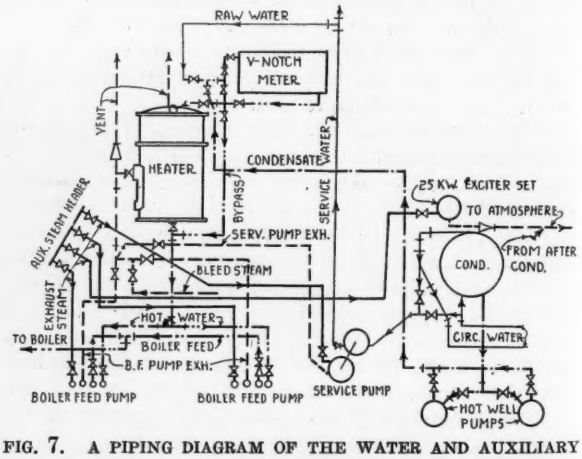


FIG. 7. A PIPING DIAGRAM OF THE WATER AND AUXILIARY STEAM LINES SHOWS THE GENERAL ARRANGEMENT OF EQUIPMENT

2200-v., 600-r.p.m. induction motor. Push button control is provided from three points and automatic signals warn the turbine operator if the water fails for any reason. Water from the condenser is discharged to the lower end of the lake.

denser is in operation or not. Provision has been made to clean the condenser with rubber plugs three times a year. Emergency water is supplied by a 4-in. remote controlled pump located in another building. This pump will deliver 500 g.p.m. against a total head of 375

Principal Equipment in Peninsular Plant of Consolidated Cement Corporation

Boilers

2 Edge Moor Iron Co., 900-hp., four pass, vertically baffled, water tube waste heat boilers. Each boiler has 330, four-inch, 9-gage, seamless steel tubes, 25 ft. long, Power Specialty Co. Foster superheater and a 3885 sq. ft. Foster economizer, 10 tubes wide and 12 tubes high. Steam conditions, 225 lb. gage 150 deg. superheat.

1 Edge Moor Iron Co., 348-hp., hand-fired auxiliary boiler with Foster superheater and McClave-Brooks Co. shaking grates.

8 Manning, Maxwell & Moore, Inc., consolidated safety valves, three 4-in. valves on each waste heat boiler, two 3½-in. valves on auxiliary boiler and 2½-in. valves on each superheater.

2 Green Fuel Economizer Co. paddle wheel induced draft fans with a capacity of 300,000 lb. of gas per hr., driven by a 150-hp., 2200-v., 3-phase, 60-cycle, Allis-Chalmers, 514-r.p.m. slip ring motor with a maximum speed reduction of 50 per cent in 13 steps.

1 Elliott Co., 80,000 lb. per hr. deaerating feed water heater.

1 Yarnall-Waring Co., V-notch meter.

3 Northern Equipment Co., Copes compound port boiler feed regulators.

6 Lewis M. Ellison inclined draft gages.

4 Bailey Meter Co., integrating and recording steam flow meters with pressure recording pen.

2 Bailey Meter Co. six point indicating draft gages.

4 Bristol Co. recording draft gages.

2 Brown Instrument Co., 4 point indicating pyrometers.

4 Brown Instrument Co. recording pyrometers.

2 Brown Instrument Co. three pen recording thermometers.

5 Yarnall-Waring Co. blowoff valves and cocks.
Lunkenheimer Co. high pressure steam valves.
Golden-Anderson Valve Specialty Co., non-return and boiler stop valves.
Crane Co. low pressure valves.
Brickwork and boiler setting, Rust Eng. Co.
Cochrane Corp. steam separators and high pressure traps.
Celite Prod. Co. Sil-o-Cel dampers.

Pumps and Condensers

2 Allis-Chalmers Mfg. Co., 2-in., six-stage, Type V, 150-g.p.m., 650-ft., 3600-r.p.m. boiler feed pumps driven by

2 Terry Steam Turbine Co., 3 B, 45-hp., split case, 225-lb., 150 deg. superheat non-condensing turbines.

1 C. H. Wheeler Mfg. Co., size 14 in. centrifugal condenser circulating water pump driven by

1 Allis-Chalmers, 120-hp., 600-r.p.m., 2200-v., 3-phase, 60-cycle induction motor.

1 Penberthy Injector Co., 12-gal. cellar drainer.

1 C. H. Wheeler Mfg. Co., size 2½, centrifugal hotwell pump, driven at 1730 r.p.m. by an Allis-Chalmers, 10-hp., Type AR, 440-v. motor.

1 C. H. Wheeler Mfg. Co., 2-stage twin radojet with surface aftercooler.

1 Allis-Chalmers, 1-in., Type HYC centrifugal auxiliary service water pump. Capacity 500 g.p.m. against a total head of 375 ft. at 1750 r.p.m. Driven by an Allis-Chalmers, 100-hp., 2200-v. induction motor.

1 Allis-Chalmers Mfg. Co., size 6, Type SH, 1250-g.p.m., 253 ft. head, 1800-r.p.m. centrifugal service water pump, driven by an Allis-Chalmers, 135-hp., 2200-v. induction motor.

1 C. H. Wheeler Mfg. Co., horizontal, 2-pass, 6000-sq. ft. surface condenser, made up of 1900 brass tubes ⅝ in. in diameter and 17 ft. long.

2 E. B. Badger & Sons Co., 30-in self-equalizing expansion joints.

Generators and Electrical Equipment

2 Allis-Chalmers Mfg. Co., 3600-r.p.m., 1250-kw., 3-stage, reaction type turbines, arranged for bleeding from last stage.

2 Allis-Chalmers Mfg. Co., 1562.5-kv.a., 80 per cent P. F., 2300-v., 3-phase, 60-cycle generators with full load continuous temperature rise of 60 deg.

1 Allis-Chalmers Mfg. Co., 30-kw., 125-v., motor-driven exciter, Type EI-121, driven at 1750 r.p.m. by an Allis-Chalmers, 46.5-hp., 440-v., 40 deg. motor.

1 Allis-Chalmers Mfg. Co., turbine-driven, 125-v., 25-kw. exciter driven by an Allis-Chalmers, 3600-r.p.m. non-condensing turbine.

1 General Electric Co., 11-panel black slate switchboard, complete with instruments, synchronoscope and

1 General Electric Co., Type TA 145, Form F6 voltage regulator.

2 Griscom-Russell Co., fin type generator air coolers.

2 Brown Instrument Co., two pen recording thermometers with electric alarm attachment.

1 General Electric Co., 750-r.p.m., motor generator set with a 440-v., 115-hp. motor and a 75-kw., 750-r.p.m., 250-v. d. c. generator.

Miscellaneous

1 Ingersoll-Rand Co., 11 by 14-in. duplex air compressor close belted to an Allis-Chalmers, 100-hp., 700-r.p.m., 2200-v. induction motor.

1 Whiting Corp. 20-t. crane.

Service water for the entire plant and for the fire service is normally furnished by a 1250-gal., 253 ft. head, 1800-r.p.m. centrifugal pump driven by a push button controlled, 135-hp. motor. Suction for this pump can be taken from either the discharge or intake to the condenser so that water can be supplied whether the condenser is in operation or not. Provision has been made to clean the condenser with rubber plugs three times a year. Emergency water is supplied by a 4-in. remote controlled pump located in another building. This pump will deliver 500 g.p.m. against a total head of 375 ft. when operating at 1750 r.p.m. It is driven by a 100-hp. induction motor, takes its suction direct from the lake through a separate line and is kept on the line, permanently primed at all times. Each operator starts it each shift to insure its operation in an emergency.

Generator cooling air is supplied from a closed sys-

tem with fin type surface cooler and each generator is provided with a three point indicating pyrometer with thermocouples imbedded in the general coils. Recording thermometers recording the temperature rise of the air through the generator sound an electric gong to warn the operator in case of excessive heating.

Each boiler is equipped with a complete operating panel, upon which are mounted nine instruments, as shown in Fig. 4. A six point indicating draft gage shows the draft in the main flue, before the superheater, after the superheater, after the second pass, before the economizer and after the economizer. Two recording draft gages record the draft in the kiln housing and in the flue leading to the fans respectively. Below these two recording pyrometers record temperatures at the same points while a four point indicating pyrometer gives the temperature of the gas entering the boilers, leaving the superheater, leaving the second pass and entering the economizer. Temperatures of the steam leaving the superheater and of the feed water entering and leaving the economizer are recorded on a three point recording thermometer, while the steam flow and pressure between the boiler and header and between the header and turbines are recorded by two flow meters. Both meters are of the integrating type.

TYPICAL OPERATING CONDITIONS WITH ONE BOILER OPERATING, THE MAIN DAMPER OPEN 24 IN. AND THE INDUCED DRAFT FAN RUNNING ON 10 POINTS

Steam press., lb. gage	220
Steam temp. at turbine	486
Temp. gases entering boiler	1215
Temp. gases leaving boiler	500
Temp. water entering economizer	131
Temp. water leaving economizer	297
Draft at kiln housing	0.31
Draft at main flue	0.36
Draft entering superheater	0.51
Draft leaving superheater	.54
Draft between 2 and 3 pass	2.8
Draft entering economizer	4.8
Draft leaving economizer	6.0
Electric load, kw.	1850.0

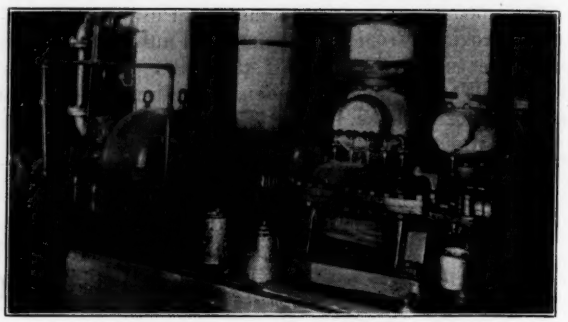


FIG. 8. TWO SIX-STAGE TURBINE-DRIVEN BOILER FEED PUMPS SUPPLY FEED WATER TO THE BOILERS

SHORT PERIOD OF OPERATION PROVES INSTALLATION JUSTIFIED

Although the new plant has been in service only a short while, operating results are up to expectations and records of the first few weeks' operation show that the combined coal consumption for kilns and power house

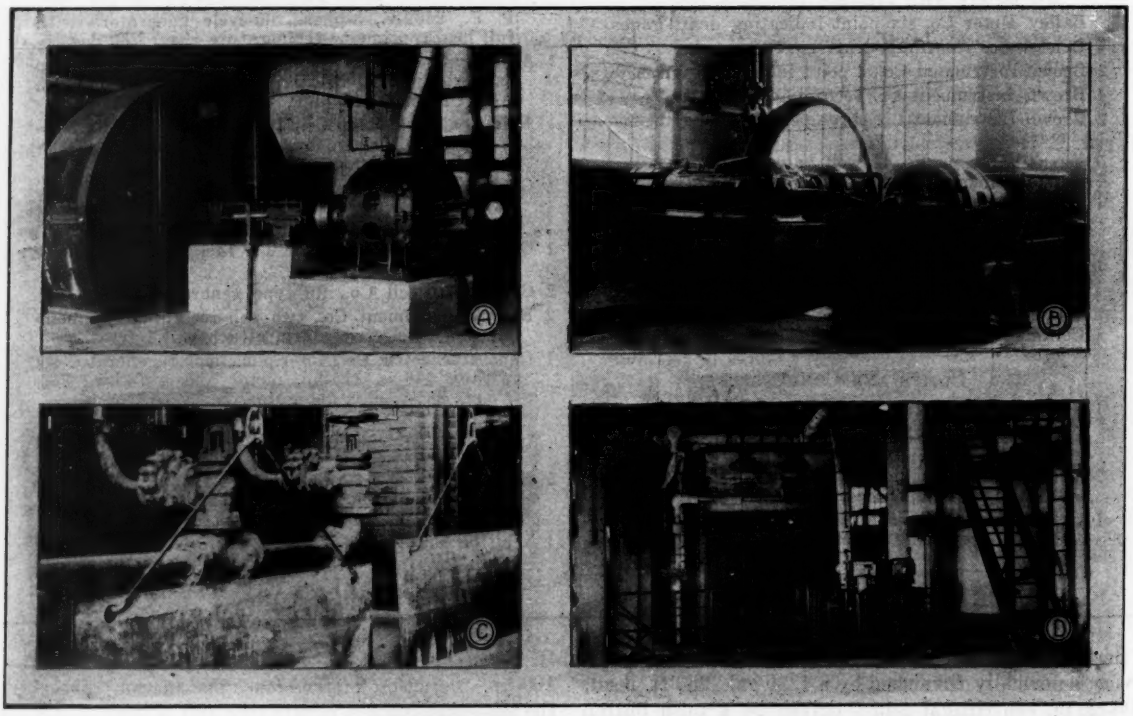


FIG. 9. INDUCED DRAFT FANS (A) HANDLE ALL GASES THAT PASS THROUGH THE BOILERS, THE DAMPERS (C) CONTROLLING THE INDUCED DRAFT FANS ARE RAISED OR LOWERED BY CHAIN BLOCKS WHICH CAN BE SEEN AGAINST THE STEEL BOILER CURTAIN (D). THE COMPRESSOR (B) SUPPLIES AIR FOR THE PLANT AND FOR DUSTING THE BOILER TUBE

has been reduced to 75.77 per cent of that formerly used per barrel of clinker burned. Water rates of the new turbines at full load have been found to be about 14.9 lb. per kw-hr. and at three-quarter load about 15.8 lb. as compared with an average of about 26 lb. for the old plant. Average test results over a period of about 2 hr. taken while conditions were constant for a short period during a 24 hr. test are given in the accompanying table. During this time both kilns were in operation, the main flue damper was open 24 in. and the safety valves were blowing intermittently. Gas conditions vary somewhat under different conditions, a rough average of a number of orsat readings showing about 20 per cent CO_2, 0.5 per cent CO and 1.5 per cent O_2.

Ample provision has been made for increased capacity and a third turbine with an individual condenser will be installed in the future as the load demands. Thus after more than 20 yr. the plant which first attempted to utilize waste kiln gases, is at last equipped with a complete modern waste heat installation and will continue to hold a prominent place in the front rank of modern cement mills.

Concrete Used for the Power Plant

STRENGTH OF CONCRETE AND RAPIDITY OF CURING DEPEND LARGELY ON PROPORTION OF MIXING WATER. BY DUFF A. ABRAMS*

ALTHOUGH the power plant engineer is primarily interested in operating problems, he must frequently give attention to construction details, which make necessary a working knowledge of structural materials.

Concrete is widely used in modern power plants in the construction of buildings, chimneys, boiler, pump and engine foundations, steam pits, coal storage and ash pits, tunnels, conduits, condensing ponds, etc. Its fireproof nature, inherent strength, permanence, resistance to vibration and adaptability to special forms account for its extensive use.

Concrete is a mixture of portland cement, fine and coarse aggregates and water. The mixture of water and cement may be considered as a paste holding the aggregates together. This is the fundamental principle of concrete mixtures; in other words, so far as proportions of constituent materials is concerned, the strength of concrete depends largely on the proportion of mixing water as compared to the quantity of cement—the water-cement ratio. The more mixing water, the less the adhesion of the paste. The aggregates (sand and gravel or crushed stone) are used primarily for economy and may be added to the paste in many different quantities or combinations, provided the mixture is plastic and can be easily puddled in place and around the reinforcement.

In general, the compressive strengths given in Table I can be expected at 28 days when the concrete is cured damp at about 70 deg. F. and tested in the form of 6 by 12-in. cylinders.

Free water carried by the aggregates must be considered as part of the mixing water. In other words, a deduction must be made from the amounts of mixing water in the above table to allow for the moisture carried by the aggregates. For ordinary aggregates, the following general rule is applicable:

Very wet sand contains ¾ to 1 gal. of water per cu. ft.
Moderately wet sand contains about ½ gal. per cu. ft.
Moist sand contains about ¼ gal. per cu. ft.
Moist gravel or crushed rock contains about ¼ gal. per cu. ft.
The coarser the sand the less water it will carry.

For accurate control the only satisfactory method is to determine the moisture content by weighing a small quantity of the moist aggregate, drying and reweighing. The difference between the moist and dry weight is the weight of water. This value can be converted into gallons by dividing by 8.33, the number of pounds of water in a U. S. gallon.

TABLE I. VARIATION OF COMPRESSIVE STRENGTH WITH AMOUNT OF MIXING WATER

Mixing Water U. S. gal. per sack (94 lb.) of Portland Cement	Approximate Compressive Strength of Concrete at 28 Days, lb. per sq. in.
5	3800
5½	3400
6	3000
6½	2600
7	2300
7½	2000
8	1700

From the above table the serious reduction in concrete strength from increasing the amount of mixing water is apparent.

For concrete materials, the general requirements given below must be followed. The cement must pass the "Standard Specification and Tests for Portland Cement" of the American Society for Testing Materials. The water must be clean and free from injurious amounts of oil, alkali, organic materials or other deleterious substances. Water suitable for drinking purposes may be safely used for mixing concrete. The aggregate should be clean, structurally sound and free from injurious amounts of organic impurities, shale, mica or soft materials. Natural sand, crushed rock or gravel may be used. The maximum permissible size of coarse aggregate depends on the dimensions of the work; sizes up to 1 or 1½ in. are most common.

Best results can be secured by mixing for one minute or more in a concrete mixer of standard type. Small quantities of concrete can be mixed by hand with shovels on a water-tight platform. The cement and sand should be mixed dry until the mass is of a uniform color; the water and coarse aggregate should then be added and the entire mass turned at least three times or until a homogeneous mixture of the required workability is obtained.

Damp curing, higher temperature while curing and longer mixing all increase the early strength of concrete.

*Director, Research Laboratory, Portland Cement Association, Chicago.

Concrete is ordinarily designed for strength, but durability for the particular conditions of exposure should not be neglected. The durability of concrete is measured by its ability to resist the penetration of moisture. This resistance is, in general, proportional to the compressive strength. The factors which produce greater compressive strength (low water-ratio, ample mixing and proper curing) also produce greater resistance to the penetration of water or to the action of other destructive agents. For permanent construction special care is required to avoid over-wet mixtures or excessive spading or puddling; these extremes cause the finer particles to work to the surface, forming laitance, a fine powdery material which is easily dusted off or attacked by moisture and frost.

In the newer specifications, the number of gallons of water for each sack of cement is specified, leaving the proportions of aggregate largely to the discretion of the contractor. The proportions may readily be determined by trial batches, in order to secure the proper workability with the aggregates used.

The older form of specification gave the proportions of cement and fine and coarse aggregates, but left the water content to the discretion of the contractor and often resulted in the use of very wet mixtures with correspondingly low strength and durability. This method is still in use, largely due to the fact that recent developments have not become universally known and that practical concrete men are slow in acknowledging that this scientific method produces the best concrete and at the same time is more economical. When arbitrary proportions are used, it is important that the mix be made smooth and workable, and that excess water be avoided. Table II gives typical mixtures for various types of structures; the proportions are expressed as one sack of portland cement (1 cu. ft.) the indicated number of cubic feet of sand (graded up to ⅛ or ¼ in.) and the indicated number of cubic feet of crushed stone or pebbles.

Forms for concrete are made of wood or steel. When the former is used it should be partially seasoned; kiln-dried lumber will absorb water from the concrete and swell and bulge, while green lumber will dry out and shrink. In ordinary cases, care should be taken to frame the form work to allow for some swelling of individual parts without distortion of the whole.

Spruce, fir and Southern pine are generally used for studs, posts and joists, while yellow pine, Norway pine and fir are suitable for the sections in contact with the concrete, such as sheathing and flooring. Where the cost is not prohibitive, white pine is frequently used for the sides and bottoms of beams and girders. Lumber should be free from knots and other imperfections which will affect the strength of the form or the finished concrete surface.

Size of lumber to be used will depend upon the kind of wood, the load to be supported, etc. Ordinarily ⅞ to 1-in. lumber is used for sheathing and flooring when the forms are to be used but a few times; when more service is required, 1½-in. lumber should be used. Posts and shores should be 4 by 4 or 6 by 6-in., placed 5 ft. center to center. Cross-ties, ledger boards and bracing are usually 1 by 6 or 1½ by 6 in.

Metal forms are of two main classes; those in which the form becomes a part of the structure and those in which it is removed. In the first class, are the steel floor domes and cores, special types of corrugated plates and the various forms or ribbed metal lath which serve as a form during concreting and later serve as reinforcement. The second class consists largely of column, wall and floor forms.

Steel is advantageous when a rounded or a very smooth surface is required; forms for circular columns are generally of steel.

Reinforcing (generally round or square steel bars ⅜ to 1¼-in.) are embedded in the concrete to take the tensile stresses, in beams, floors, footings, etc., and to resist compressive stresses in columns. The size and the location of the bars depend on the type of structure and the load to be carried; hence, no general formulas for design can be given. The steel should be clean and free from rust. The designing of reinforced structures should be referred to an experienced structural engineer.

Concrete structures, such as pavements, sidewalks or retaining walls 50 ft. or more in length, should be provided with expansion joints. The reinforcing should not join the two parts. The joints are usually filled with asphalt, tar, or other elastic waterproof material.

TABLE II. TYPICAL MIXTURES FOR VARIOUS TYPES OF STRUCTURES

Type of Structure	Concrete Mix
Caissons	1-2-4
Channel and canal beds	1-2-3
Condensing ponds	1-2-4
Columns	1-1½-3
Driveways	1-2-3½
Floors	1-2-4
Wearing surface	1-2
Foundations	1-2-4
Footings (unreinforced)	1-2½-5
Piers	1-2-3
Retaining walls	1-2-4
Retaining walls to be exposed to water pressure	1-2-3
Steam pits	1-2-4
Steam tunnels and conduits	1-2-4
Tanks	1-2½-3½
Walls (building, etc.)	1-2-4

In order that the machinery in a power plant may be attached to the floors and ceilings, metal inserts should be put in the forms before the concrete is placed. These will become permanent fixtures and integral parts of the structure. For permanent piping, the inserts for pipe hangers should be laid out as soon as the system is designed and the inserts accurately placed on the forms before concreting is begun. For shafting and machinery, however, the inserts should be located three feet apart in each direction. This arrangement enables equipment to be rearranged at any time.

One of the most persistent ideas regarding concrete is that it cannot be placed in winter. Many important buildings and other outdoor structures have been erected when the temperature was in the vicinity of zero.

In cold weather both aggregates and water should be heated before mixing. The placed concrete should be protected from outside temperature by canvas tarpaulins and the adjacent air warmed to 50 deg. F. or

over by means of steam pipes or salamanders. The heat should be maintained for at least five days, so that the hardening process may have a good beginning.

Aggregates may be heated by piling them over 1½-in. steam pipes or by inserting 6-ft. lengths of perforated steam pipe into the pile. A 1½-in. steam pipe run into the water barrel will heat the mixing water. One salamander is sufficient to heat 300 sq. ft. of floor area. Fuel should be applied frequently and in small quantities, so that the temperature will be uniform. In order to maintain sufficient moisture, tubs of water should be placed near the salamanders.

Care must be taken during winter construction, but under proper supervision a structure erected during this season will be as sound as those built during the summer months.

During hot weather, precautions must be taken to prevent too rapid drying. If the air is dry, the concrete should be sprinkled daily for from one to three weeks. Exposed concrete in forms should be kept wet until the forms are removed, and after that all surfaces should be sprinkled. Exposed areas are often covered with canvas, which is kept wet; pavements may be cured by covering with dirt, which should be kept wet. These precautions prevent rapid drying and insure a properly hardened product.

While it is generally considered desirable for concrete to cure 14 to 28 days before it is subjected to load, it is entirely feasible to make portland cement concrete which can be put into service 2 to 4 days after mixing. By using 20 to 30 per cent more cement, mixing as dry as possible in order to produce a plastic concrete by tamping, compressive strengths of 2500 lb. per sq. in. or more can be secured at three days. A concrete pavement may be built, excluding traffic only three days; a longer period will be required in cold weather.

Operation of the Intermittent Type Governor

DETAILS OF CONSTRUCTION AND INSTRUCTIONS FOR THE ADJUSTMENT OF THE INTERMITTENT TYPE GOVERNOR. BY A. W. KIRTON*

IN THE SEPTEMBER 15 issue, in the article, Principles of Steam Turbine Governors, there appeared, among others, a short description of the intermittent type governor. Naturally, in an article of such a general nature, only a brief treatment of any one type of governor is possible and in this present article a more detailed discussion will be presented.

As stated in the article referred to, with this type of governor, governing is accomplished by varying the port area of the valves admitting steam to the turbines.

For large turbines, the governor is of the flyball central spring type shown in Fig. 1, a cross section of which is shown in Fig. 2. It is operated from the main turbine shaft through a worm gear. In operation the centrifugal force of the revolving weights is transmitted to the spring collar by the weight arms and counterbalanced by the governor springs.

Any movement of the weights is transmitted through the spring collar connected by struts "S" to the clutch, operating the clutch lever which transmits the movement through the rock shaft "E," shown in Fig. 3, to the oil relay valves controlling the steam admission valves.

On one end of the governor clutch lever, as seen in Fig. 2, an oil dash pot is provided to dampen any tendency of the governor to surge or hunt during sudden changes of load.

Any sluggish action of the governor or oil relay control system due to the friction of rest is overcome by a slight oscillation transmitted to the control linkage by a vibrator rod, which can be seen in Fig. 2. This rod, with a roller "T" on the lower end, receives a reciprocating motion from a beveled cam on the upper side of the oil pump shaft gear. The oscillation produced is so slight that it does not cause any appreciable fluctuation in the steam flow but it is sufficient to make the oil relay control and the governor mechanism sensitive and quick in its response to the changes in the position of the governor weights.

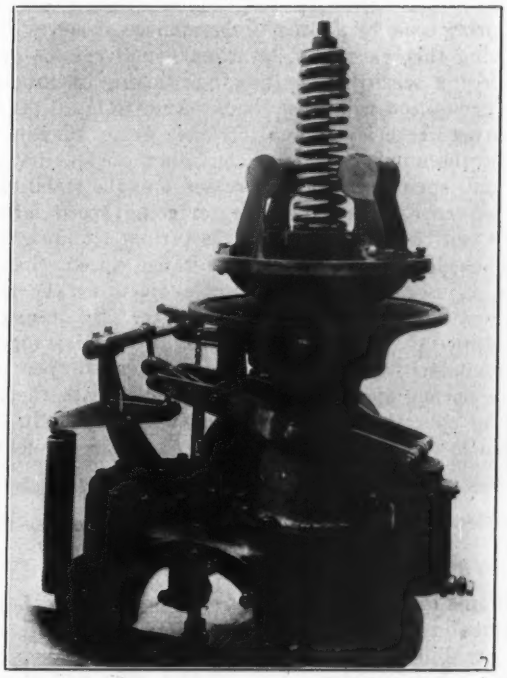


FIG. 1. VIEW OF INTERMITTENT TYPE GOVERNOR WITH PROTECTING COVER REMOVED

The speed adjustment of the governor is made by changing the tension of the governor spring by means of the nut "G," shown in Fig. 2. When the nut is screwed down on the governor spindle, it causes an increase in the spring compression and speed. Vice versa, slackening the nut back has the opposite effect. The governor spring, when used in conjunction with the speed changer, is usually adjusted so that the turbine will operate at 5 per cent below normal speed.

Speed variation, which is usually about 3 per cent between no-load and full load, can be changed by altering the position of the governor spring adjusting-sleeve,

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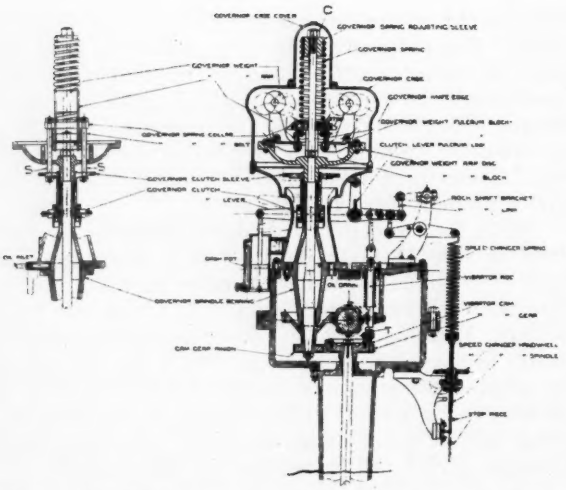


FIG. 2. SECTIONAL VIEW OF GOVERNOR SHOWN IN FIG. 1

shown in Fig. 2. To increase the sensitiveness of the governor, that is, to decrease the percentage regulation, the adjusting-sleeve holding the upper coils of the governor spring, should be screwed out, thus weakening the spring scale by adding to the number of active coils. In doing this, care must be taken not to get too great a degree of sensitiveness, thus approaching isochronism, which condition will cause the governor to hunt. If the adjusting-sleeve is screwed into the spring, thereby reducing the number of active coils, then the speed variation and spring scale are increased and the stability of the governor increased. The foregoing speed adjustments can be made only with the turbine standing idle.

The electrically or hand-operated speed changer (Fig. 2) is an auxiliary spring augmenting the main governor spring, but of less strength. By means of this device the speed can be varied through a range of approximately 10 per cent, that is, from 5 per cent above normal speed to 5 per cent below with the turbine in operation. This speed changer is usually connected to the main switchboard to facilitate the control of the turbine speed when synchronizing the generators. If necessary, the speed can be adjusted right at the turbine by means of the speed changer handwheel, shown in Fig. 2.

On the large turbines, the governor operates the steam admission valves through a high pressure, oil-relay, control system, which insures a sensitive regulation and permits the use of a much smaller governor since it merely has to operate a small relay valve.

By referring to Fig. 3, showing longitudinal and lateral cross section views "EE" and "DD," the operation of the oil relay control can be followed. The rock shaft "E," which operates the relay valve "B," is actuated by the governor through suitable linkage. The relay valve case contains two valves, the pilot valve "B" controlled by the governor, and the automatically-operated emergency closing valve "W" controlled by the auto stop governor. Both these relay valves are of the balanced type.

The pilot valve "B," under control of the main governor, regulates the admission of high pressure oil (about 60 lb.) to the top and bottom respectively of the operating piston "A" through passages "I." Passage "H" connects the discharge side of both valves with the low pressure oil lubricating system carrying a pressure of 5 lb.

Governing is accomplished by a slight variation in speed producing a corresponding variation in the position of the governor weights. That is, an increase in load will slow down the turbine slightly, moving the governor weights inward and the end of floating lever "G" attached to the governor clutch sleeve lever (Fig. 2) through rock shaft "E" (Fig. 3), will be raised, turning about its opposite end "K" as a fulcrum. This raises the pilot valve "B" and admits high-pressure oil to the upper side of the operating piston "A" through passage "I," exhausting the oil from the lower side of the piston through the passage "II." This difference of pressure forces the piston "A" down, opening the admission valves "O" and "P" through levers "M" and "N." In the meantime, the movement of piston "A" through point "K" lowers the floating

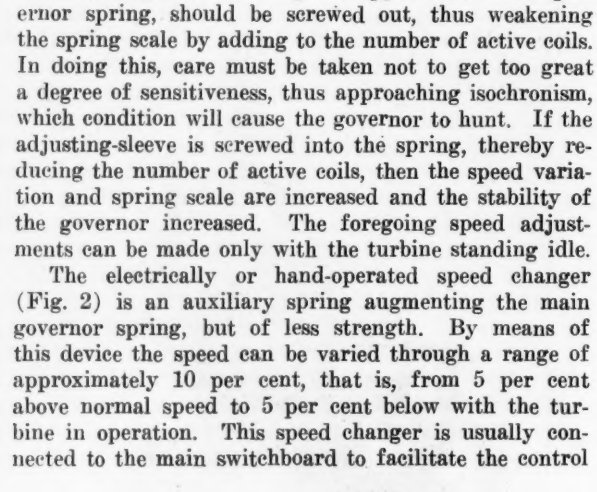


FIG. 3. VALVE MECHANISM AND OIL RELAY

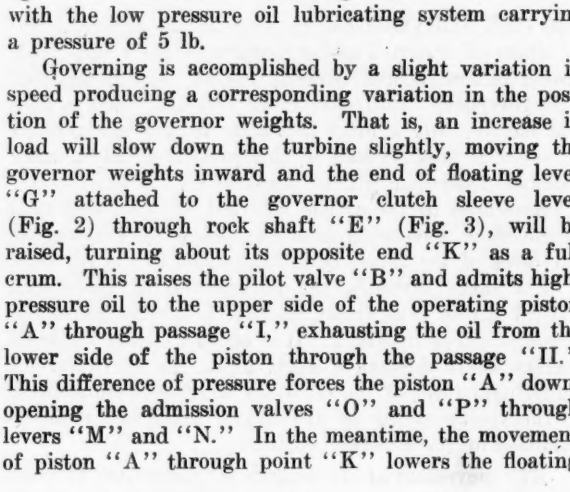


FIG. 4. DETAILS OF OVERSPEED GOVERNOR

lever "G" about the fulcrum point ' J" bringing the pilot valve "B" back to its neutral position, shutting off the oil flow to the piston "A" and holding it stationary until there is a further movement of the governor weights. An outward movement of the governor weights will have the reverse effect.

The two levers "M" and "N," which transmit the movement of the piston "A" to the primary and secondary admission valves "O" and "P," are the same except that the secondary valve lever ' N" is provided with an adjustable lost motion link "H" so that the secondary valve "P" can be regulated to open as soon as full inlet pressure is being admitted to the turbine by the primary valve "O."

In the oil relay control system a second relay valve "W" (Fig. 3) is incorporated and acts as an emergency closing mechanism for the admission valves, in addition to the emergency closing device on the throttle valve. The differential piston "Q" (attached to the relay valve "W") is held in its top position by steam pressure through pipes "U" and ' V" holding the relay valve "W") in its open position. When the automatic safety stop governor functions, the steam pressure under the differential piston "Q" is released through the pipe "V" and the difference in pressure forces the piston "Q" to its bottom position, moving the oil relay valve "W" down to admit full oil pressure to under side of the piston "A" and exhausting the pressure on the upper side. This forces the piston ' A" up, closing the admission valves irrespective of the position of the governor controlled oil relay.

All turbines, with the exception of some of the smallest, are equipped with an auto stop governor usually fitted on the end of turbine shaft in order to prevent overspeeding. The principle of operation can be followed by reference to Fig. 4. A small weight "A," with its center of gravity a little off the center of rotation and its line of motion perpendicular to the axis of rotation, is held in the auto stop governor body by a spring. When the centrifugal force moves the weight outward it strikes the trigger cam "B" which removes the trigger from under the valve lever "G," allowing the auto stop valve "I" to open, which releases the steam pressure under the differential pistons attached to the throttle valve and the emergency oil relay valve and closes them. The action of the auto stop weight "A" is almost instantaneous due to the fact that once the weight starts to move outward its centrifugal force rapidly increases but the compression of the spring remains practically constant, which causes the outward velocity of the weight to be highly accelerated. The auto stop governor can be set to operate at any predetermined speed by adjusting the spring holding the weight "A." Usually it is set to operate at 10 per cent above the normal speed of the turbine. If necessary, the auto stop governor can also be operated by hand.

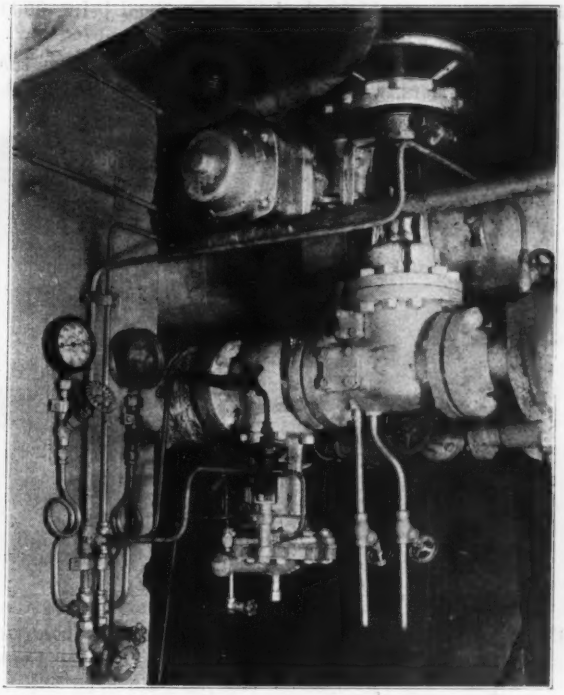
ACCIDENTS CAUSE losses and expenses other than workmen's compensation costs, doctor and hospital bills. These additional losses are due to such causes as damaged materials, injured machinery, labor turnover and to the disorganization that naturally follows an accident. These latter losses frequently exceed the medical and compensation costs, points out C. E. Pettibone, vice-president of the National Safety Council.

Motor Control Increases Safety

LOW PRESSURE PIPING PROTECTED AUTOMATICALLY. BY H. M. COOK*

TWO OR MORE steam pressures are becoming quite common in many modern power plants, with a corresponding increase in piping complications. At Fairmont Pumping Station in the City of Cleveland 300-lb. superheated steam used in turbine-driven pumping units, is exhausted at 70 lb. and supplied to various hotels and business institutions within a radius of a mile or more, for heating.

At certain periods of the year when the heating load is heavy, the turbine exhaust is not sufficient, so the deficiency is made up by admitting live steam to the system through a reducing valve of the diaphragm type.



GATE VALVE INSTALLED ON HIGH PRESSURE SIDE REGULATES PRESSURE IF REGULATING VALVE FAILS

Failure of this reducing valve would result in admitting 300-lb. pressure to the heating system and undoubtedly cause radiator explosions in the various buildings. For this reason the regulating valve is backed up with a motor-operated gate valve under the control of a standard bourdon pressure gage equipped with electric contacts.

During the adjustments and tests the diaphragm regulator was opened wide and all regulation accomplished by means of the motor control valve, a Dean Type A-3 unit. In this manner pressure regulation could be maintained within about plus or minus 1 lb., which is considered fine regulation for equipment of this type. In actual service the diaphragm regulator is set to hold the pressure between 65 and 75 lb. but in case of a failure, the pressure rise will automatically cut in the motor-driven unit and throttle the gate valve so as to maintain a pressure of about 82 lb.

*The Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Use of Exhaust Steam Effects Greater Savings

INSTALLATION OF MIXED PRESSURE TURBINE UTILIZING EXHAUST STEAM FROM FORGE SHOP, EARNS ITS COST IN 3¼ YR. BY LOUIS HEIL*

SEVERAL YEARS AGO, having come to the conclusion that production of current in our plant was not efficient and due to the fact that many of the motors in use were getting old, we decided to build a new power plant. At that time our generating plant consisted of a 300-kw. Corliss engine unit and two 150-kw. automatic engine units, all direct connected. Steam for these was furnished by two 500-hp. boilers, one 540-hp. boiler and one 560-hp. boiler, all of our own manufacture. These boilers also furnished steam for our forging hammers, the exhaust steam from which was not utilized. The demand for steam was such that three boilers were required to carry the load, the average load being 2500 b. hp.

Realizing the value of the exhaust steam from the forging hammers, we decided to build a new plant with a mixed pressure turbine so that this exhaust steam could be utilized. It was further decided to install an alternating current generator and put some alternating current motors in the shop. After thoroughly investigating the performance of this type of equipment at various plants and considering the problem from all possible angles we installed a General Electric Co., 750-kw. alternating current turbine generator, a 3-stage, mixed pressure machine. This unit was placed in operation early in 1924.

FIG. 1. GENERAL VIEW IN POWER HOUSE SHOWING THE MIXED PRESSURE TURBINE, MOTOR GENERATOR SET AND SWITCHBOARD

Steam at boiler pressure, 140 lb., is fed to the first stage and the exhaust steam from the forging hammers and air compressor, at 2½ lb. pressure, is fed to the second stage and goes through the third stage. We try to maintain 27 in. of vacuum and can generally do so with the jet condenser.

Under ordinary summer conditions approximately 10 per cent of the steam used is high pressure steam and 90 per cent is exhaust steam from the hammers and air compressor. This makes possible an exceedingly low power cost, as the exhaust from the hammers, formerly wasted, is still considered of no value in figuring the cost of producing electric current. In the winter, as a result of the demand for steam for heating, the percentage of low pressure steam is reduced greatly at times, causing more high pressure steam to be used in the turbine.

We have installed a 240-kw. G.E. motor generator for supplying direct current for some uses in the plant. Approximately 65 per cent of the electric power used is alternating current, and 35 per cent direct current. Connection is maintained with the city lines, providing a source of current when the turbine generator is not in operation or when the demand is greater than the generator can carry.

In the past the amount of city current consumed was greater than at present because the plant was not operating at night, and the generator ran only from 6 a. m. to 6 p. m. Recently work was started in some departments at night and the generator now runs 24 hr. a day.

The average day load is approximately 650 kw., the peak load being 800 kw. At night the load is now 220 kw., but the night load will be increasing as more departments start night shifts.

Steam is still supplied by the same four boilers, two of which have chain grates and two, underfeed stokers; but we usually have but two boilers in operation to carry the load, because approximately half as much steam is required as formerly was needed. Steam is generated at 140 lb. with 100 deg. superheat. The boiler load is approximately 130 per cent of rating in summer and 180 per cent in winter.

During the last year there was produced 1,784,000 kw-hr. of electricity with the turbine generator, and 199,000 kw-hr. was purchased from the city. The cost

*Chief Engineer, The Henry Vogt Machine Co., Louisville, Kentucky.

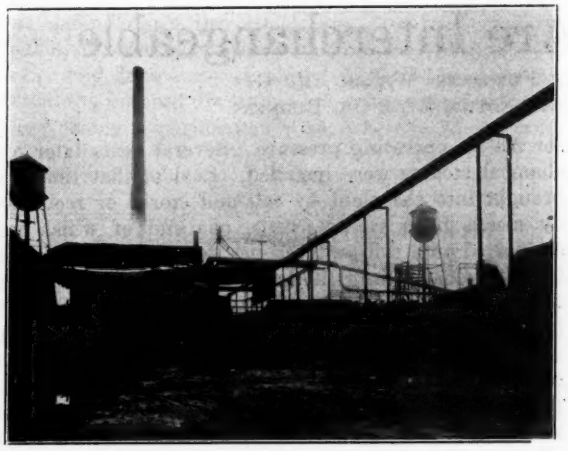


FIG. 2. EXHAUST PIPE LINE FROM DROP FORGE SHOP TO POWER HOUSE WHERE LOW PRESSURE STEAM IS USED IN TURBINE

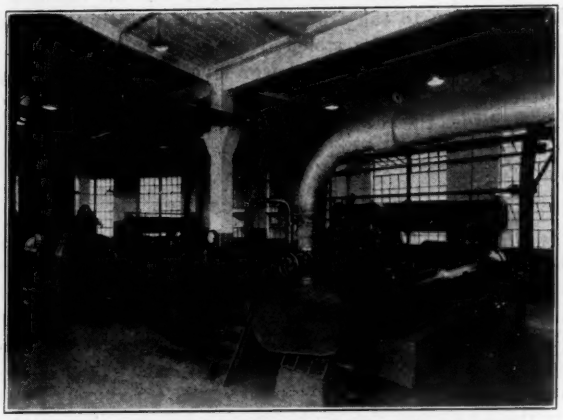


FIG. 3. STEAM DRIVEN AIR COMPRESSOR AND TURBO GENERATOR

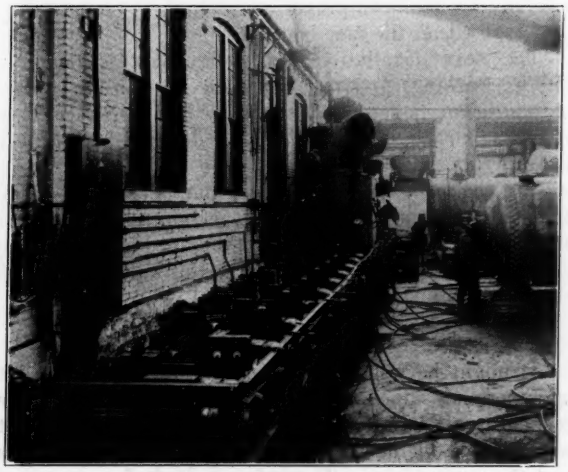


FIG. 4. PARTIAL INSTALLATION OF ARC WELDING MACHINES IN THE PLANT OF HENRY VOGT MACHINE CO., USED FOR SEALING HIGH PRESSURE GASOLINE STILLS

of current is based on the total cost of both the generated and the purchased current, and the power plant is charged for what is spent for city current. The average cost of both kinds of current was $0.015 per kw-hr.

SAVINGS EFFECTED BY INSTALLATION OF NEW EQUIPMENT AT HENRY VOGT MACHINE CO.

Total kw-hr. produced in year	1,784,000
Total bought from city	199,000
Total kw-hr. consumed	1,983,000
Average cost per kw-hr. including purchased current	$ .015
Average cost per kw-hr. formerly	.035
Net saving per kw-hr.	$ .020
Saving per year—$.02 by 1,983,000	$39,660.00
The above costs include overhead expense.	
Cost of the investment, including turbine, generator, building and auxiliaries, piping, etc.	$130,000.00
Savings repays the investment in 3¼ yr.	

Under the old conditions, before we had the present equipment, the cost of current averaged $0.035 per kw-hr. The new plant and equipment has resulted in a net saving of $0.020 per kw-hr. Last year, when 1,983,000 kw-hr. were consumed, this saving amounted to $39,660, an excellent return in the investment in plant and equipment. The total cost of power plant and equipment and new alternating current motors in the factory was approximately $130,000 and the saving effected will pay for the changes and additions in 3¼ yr.

The water rate of the turbine, using all low pressure steam, is 36 lb. per kw-hr. and, using all high pressure steam, is 18 lb. per kw-hr. When running on 90 per cent low pressure steam for which no charge is made and 10 per cent high pressure steam, the power cost is extremely low. In the year and a half during which the turbine generator has been in operation the total repairs have been but $30 for material and labor.

GREASES ARE, in general, composed of mineral oils and saponified fats such as tallow, lard oil, degras, etc. The saponified fats act as carriers for the mineral oils which are the chief lubricating ingredient. It is reported that A. L. Nugey, a petroleum engineer with the J. G. White Engineering Corp., has developed a soapless grease which is expected to utilize many low grade refinery products in place of animal fats and alkalies, also to reduce, materially, the time required for manufacture of greases. It is claimed that the new form of grease will have 100 per cent lubricating value.

INTERESTING USES of the airplane in public utility operation are commented on by Addison W. Lee, general superintendent of the Louisville Gas & Elec. Co., which uses air maps for a variety of purposes. They are convenient for mapping electrical transmission lines and natural gas transmission lines, both preliminary and final surveys, for making river surveys for proposed hydro-electric developments, for making city maps and, last but not least, for advertising purposes.

Oil and Gas Burners Are Interchangeable

Interesting Results Obtained in Furnaces Where the Gas Burners Can be Replaced on Short Notice with Oil Burners

THREE NATIVE FUELS are available in the state of Kansas, these being coal, oil and natural gas. These fuels have all been used at the Kansas Gas & Electric Co.'s Wichita Plant, which is rated at 30,000 kw., and is located at the confluence of the Big and Little Arkansas Rivers. Generating equipment consists of two 10,000-kw. units, one 4000-kw. unit and one 6000-kw. unit. Condenser water is taken from above a dam in the Little Arkansas River and is discharged

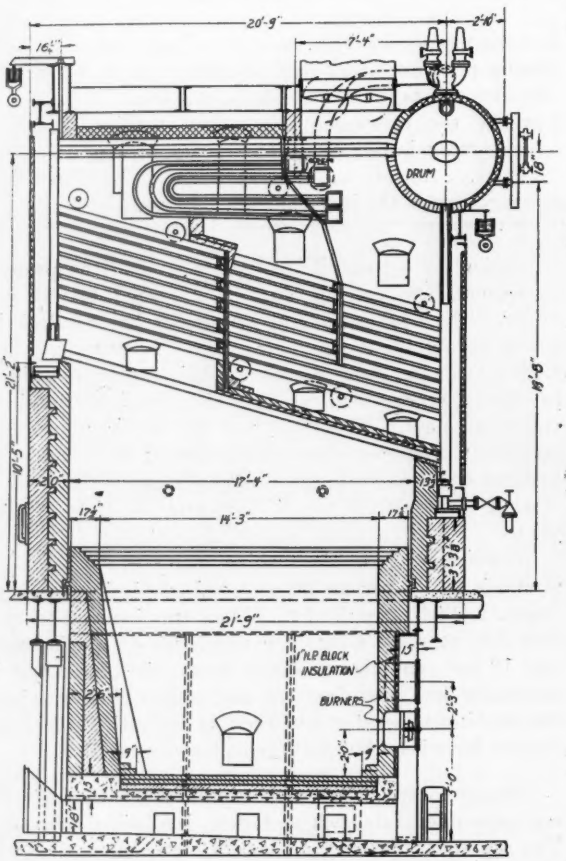


FIG. 1. COMBUSTION AIR PASSES BENEATH THE FURNACE FLOOR

into the Big Arkansas River. In the event of a shortage of water, a portion of the discharge water is sprayed and returned to a point near the intake. An auxiliary pumping unit has been installed so that water may be drawn from the Big Arkansas River and discharged above the dam, where it will be available for circulating purposes should there be a shortage at that point.

Boiler feed water is obtained from wells and is treated by a lime and soda ash softening process, and then filtered. It is under automatic regulation to the boilers.

Originally there were installed in this plant four 5680-sq. ft. Babcock & Wilcox, longitudinal-drum boilers. They were installed in 1912, and were designed for 200-lb. operating pressure. Several years later mechanical stokers were installed. Coal at that time was brought into the plant by rail and stored or reclaimed by means of a gantry crane, one end of which was supported on a rail on the boiler house roof. The crane bucket unloaded into the hopper of a crusher car from which the coal was unloaded directly into the boiler house bunkers. Although not used, this coal-handling and preparing equipment is still available and the beams for the crusher track are in place opposite the newer boilers so that it will be a comparatively easy matter, as far as this equipment is concerned, to extend it for all the boilers.

These first boilers discharge their gas to a separate steel stack. In changing back to oil and gas-firing it was deemed advisable not to disturb the stokers which were set in a Dutch oven furnace. Accordingly, a furnace wall was constructed from what was the basement floor level up to the front header, thus sealing off the Dutch oven and the stokers. The oil and gas equipment was installed at the lower level, thus establishing that as the firing floor for all future boilers and also determining the fact that all boilers would be fired from the back end, that is, the lower header end of the boiler.

Pressure was Increased

When the change in method of firing was first made on these boilers, either oil or gas was fired. With the addition of new boiler units came an increase in pressure. The new generating units were also to operate at the higher pressure, so that now but one generating unit operates at the low pressure. It can be operated by steam from the old boilers or through a reducing valve in the line from the high-pressure boilers. The latter method is practiced because these boilers are operated only in the event of emergency.

Oil-burning equipment installed under the old boilers was of the steam atomization type, which has given way to the high oil-pressure, mechanical atomization type as used on the new boilers.

The next installation consisted of six 5680-sq. ft., 250-lb. working pressure, Babcock & Wilcox, longitudinal-drum boilers and the last installation consists of two 11,860-sq. ft., B. & W., cross-drum boilers, which also operate at a pressure of 250 lb. These eight boilers are the ones which are in regular operation. They are equipped with Sturtevant economizers which operate under the full pressure of the feed water to the boilers, the waste gas from the eight units being discharged into a steel stack.

Damper Position Changed

It might be well to mention here an interesting bit of experience which was had with the operation of the economizers. Originally, the control of furnace draft was effected by means of dampers between the boilers and the economizers. The induced draft fans were, of course, between the economizers and the breeching to the stack. It was found that as the dampers were closed, the air leakage into the economizers increased,

thus cooling down the economizers. To overcome this trouble, the dampers, referred to, were taken out of service and dampers were placed between the economizers and the induced draft fans. A motor-operated device is now being experimented with, whereby the position

5 in. below this header are supported on steel beams which also support the upper operating floor. The lower portion of the furnace is built within these walls and is supported on the lower or firing floor. Connection between the upper and lower portions of the furnace

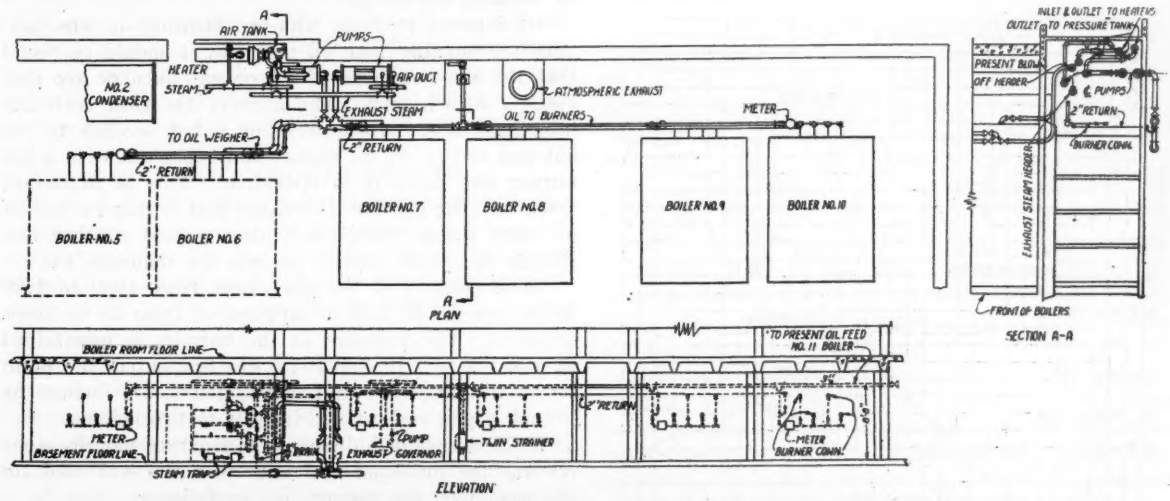


FIG. 2. OIL-BURNING EQUIPMENT IS PROVIDED TO SUPPLEMENT GAS-FIRING

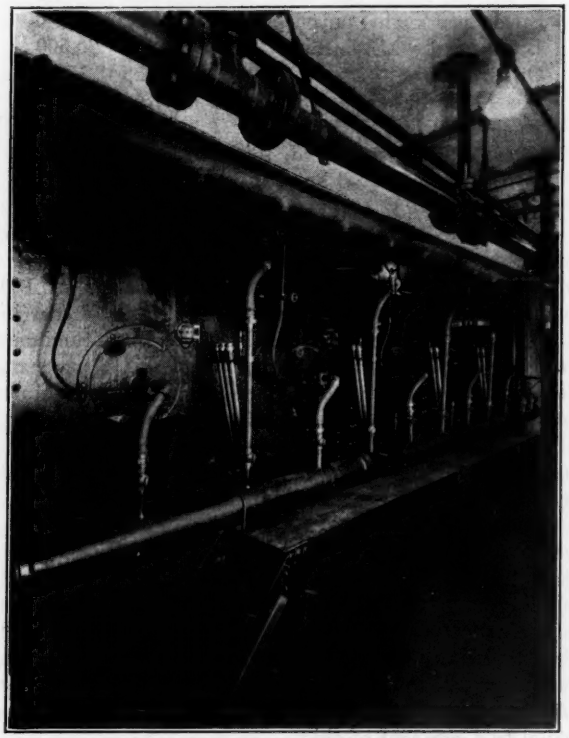


FIG. 3. GAS BURNERS MAY BE REPLACED WITH OIL BURNERS SHOWN HANGING ON BOILER FRONT

of the dampers can be controlled from the operating floor.

Setting for one of the 11,860-sq. ft. boilers is shown in Fig. 1. As will be noted it is of the cross-drum type, fired from the rear and set with the uptake or front header about 19 ft. above the floor of the furnace. The furnace walls for a distance of about 10 ft.

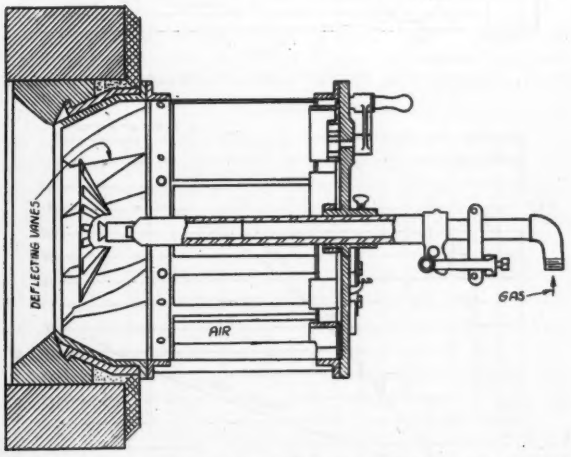


FIG. 4. AIR ENTERS AROUND THE BURNER AND PASSES THROUGH DEFLECTING VANES

is made by means of a loose joint which is packed with asbestos.

Between the firing floor and the furnace floor is an open space provided for the passage of air for combustion. Forced blast fans discharge air into this space at the opposite end from the burners, the air passing beneath the furnace floor and coming up at the burners to be discharged with the gas or oil into the furnace. This construction serves the purposes of keeping the furnace floor cool and of preheating the air for combustion.

Construction of the furnace floor is of reinforced concrete, over which are laid successively, ¼-in. mill board, one row insulating brick laid flat, ½-in. plastic insulating cement and finally two rows of fire brick laid flat. The riser air compartment to the burners is formed by erecting a sheet-steel furnace front about 15 in. from the wall.

Figure 2 shows the general layout of the oil piping for six of the eight boilers. As an assurance against a shortage of fuel, oil is stored at the city limits in four 55,000-bbl. tanks which are connected by a pipe line to one 22,000-bbl. tank and one 6000-bbl. tank located at

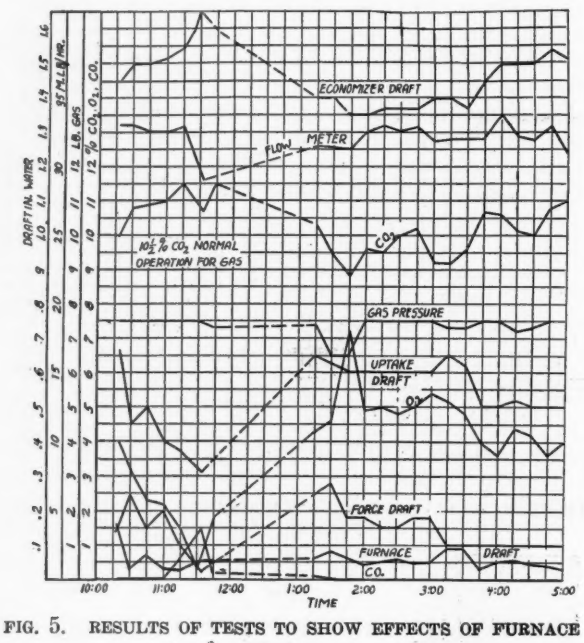


FIG. 5. RESULTS OF TESTS TO SHOW EFFECTS OF FURNACE DRAFT

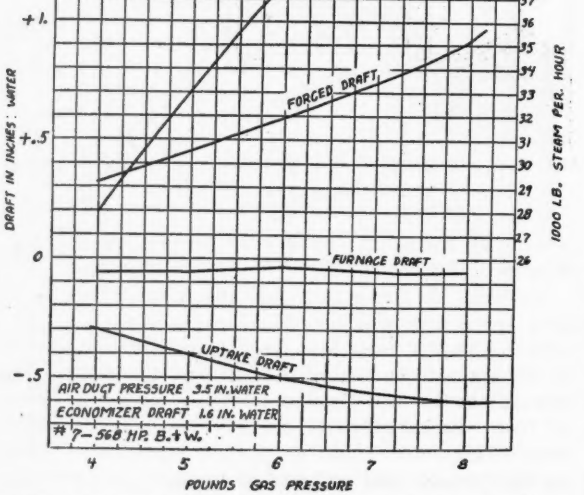


FIG. 6. OPERATING CONDITIONS WITH VARIOUS GAS PRESSURES

the plant. Fuel for the boilers is drawn from the latter by gravity to the oil weigher which is of the dump type. It is then picked up by the oil pumps which force it through the heaters, which are supplied with live steam. The temperature of the oil at the burners is about 140 deg. F. and its pressure from 120 to 160 lb.

Each of the 5680-sq. ft. units is equipped for four burners and each of the 11,860-sq. ft. units requires nine burners. The branch oil line to the group of burners on each boiler is connected to a 2-in. return line. The return line is used only when starting to insure hot oil reaching the burners.

Of interest to those who are burning or who contemplate burning both oil and gas, it should be noted that the same number of oil or gas burners are provided for each unit. The burners for both fuels are interchangeable; it requires but a few seconds to cut out and remove an oil burner and replace it with a gas burner and have it in operation. This is important when burning gas for the reason that it may be cut off on short notice, particularly during cold weather and during the peak demand periods for domestic use.

Heat content of the gas varies from 1000 to 1300 B.t.u. per cu. ft. and is supplied at from 25 to 30-lb. pressure. The pressure at the burners is maintained at about 4 to 7 lb. A 10-in. gas line enters the plant where it is metered and distributed to the boilers by branch pipes, each of which leads to two boilers.

Results obtained during two separate months when oil was the principal fuel and when gas was used for the most part are respectively as follows:

Steam produced per lb. of oil, lb...	13.9	13.4
Boiler efficiency, per cent.....	82.9	81.0
Steam per kw-hr. output, lb.....	14.5	14.6
B.t.u. per kw-hr., output.....	20,400	20,500
Oil fired, 100 lb.....	6682.8	170.6
Gas fired, 100 cu. ft.....	10,744	91,991
Fuel equivalent, 1000 lb. oil.....	7327	5927
Actual water evaporated, 1000 lb..	99,119	79,506
Kw-hr. output, 1000 hr.....	6840.5	5475.2

IN A REPORT on the development of fuels and water power in the United States, F. E. Tryon of the Bureau of Mines shows that, taking the conditions in 1918 as 100 per cent, the power developed from anthracite coal in 1925 was 63 per cent of that for 1918, for bituminous coal 90 per cent, for domestic oil burners 212 per cent, for natural gas 158 per cent, power imported from other countries 165 per cent, and water power 154 per cent. It is thus seen that while the power produced from coal has decreased since 1918 by 14 per cent, that produced by water has increased by 54 per cent.

As a comparison of the relative standing of the various sources of power for different years, it is interesting to note that in 1918 12.8 per cent of the total power was from anthracite coal, 72.3 per cent from bituminous, 10.1 per cent from domestic oil, 3.7 per cent from natural gas, and 1.1 per cent was brought in from outside the country. This gives a total of 100 per cent of power furnished from fuels, and the water power was equal to 4 per cent of this.

For the year 1925 the relative standings were as follows: For anthracite coal 7.9 per cent, for bituminous 63.6 per cent, for domestic oil 21.1 per cent, for natural gas 5.7 per cent, for power brought from outside 1.7 per cent. The water power was 6 per cent of that developed from fuel.

NOAH WAS the only man who successfully floated a stock company while the rest of the world was in liquidation.

Settings and Operation Greatly Affect Boiler Efficiencies

IN DISCUSSION of a paper on Industrial Boiler Efficiencies, presented before the A. S. M. E. at Providence by Samuel D. Fitzsimmons, results with stoker-fired boilers at the plant of the Browne & Sharpe Mfg. Co. were analyzed and interesting opinions given as to the reasons for the high efficiencies which the paper reported.

Low Setting and Wide Furnace

These boilers of inclined water tube type with box headers were made by Union Iron Works and installed over Riley underfeed stokers with vertical baffles arranged to give 1300 sq. ft. of tube surface in the first pass, 645 sq. ft. in the second and 632 sq. ft. in the third pass.

Four-inch tubes, 18 ft. 4 in. long, are spaced 5⅝ in. centers horizontally and vertically, the usual staggered arrangement vertically being used. The tube section is 9 tubes high and 17 wide, occupying 49 by 94 in., and giving 3060 sq. ft. total. Tube sectional area is 1920 sq. in. and gas passages 2686 sq. in., giving more surface for radiant heat absorption than the usual high and narrow arrangement of tube bank. No superheater or economizer is installed.

High Results Obtained on Test

In the test with West Virginia coal of heat value 14,513 B.t.u. per lb. as fired, having 2.41 per cent moisture, evaporation of 11.92 lb. was secured, equivalent evaporation of 12.44 lb. from and at 212 deg. per pound of coal as fired. Efficiency of boiler furnace and grate was 83.17 per cent, the boiler operating at 360 hp. or 120 per cent of rating. The gases were at 468 deg., which was somewhat higher than normal, due to a leaking front baffle and CO_2 was 13.1 per cent.

Mr. Fitzsimmons ascribed the high efficiency to wide setting and long tubes and stated that tubes of 20 to 22 ft. long are ranged in a bank with width three times the height would be an even more efficient arrangement. In the furnace, low rate of combustion per unit of grate surface and low rate of advance feeding gave good dissociation of volatile matter and time for nearly complete burning of combustible in the ash, although performance rates forced above 200 per cent, the combustible in ash increased rapidly.

Reasons for High Efficiency

Pressure in the air chamber of 0.8 in. water and draft in the furnace of 0.04 in. gave low velocity of air through the fuel bed and thorough mixture of air and gases at the fuel surface. While admitting that, for output in excess of 200 per cent of rating, the pulverized fuel furnace has advantages, Mr. Fitzsimmons believes that, at below 200 per cent, stokered-furnace efficiencies are obtainable commensurate with the best for pulverized-fuel furnaces. The requirement is intimate and rapid admixture of gas and air. He believes also that large horizontal area and with height only as required for the combustion of volatiles give best results in a stokered furnace. This gives better opportunity to utilize the radiant heat from the incandescent fuel bed. The furnace in the test was 8 ft. wide, 9 ft. 10 in. deep and 6 ft. 1 in. high from grate to tubes and the author felt that consequent absorption of direct and reflected radiant heat by the tubes was responsible for good boiler performance and long life of refractory linings.

Radiant Heat Is Valuable

Commenting on the results, the value of tube surface exposed to radiant heat was emphasized by Messrs. W. T. Hatch, E. N. Trump, James J. Tyrrell and James W. Armour, although Mr. Trump felt that the pulverized fuel furnace could utilize radiant heat as well as could the stokered furnace. Surface exposed to radiant heat was stated to be more effective than that which depended on convection and refractory linings and baffles should be designed to utilize this advantage. There seems no definite knowledge as to the maximum absorption of heat possible by a square foot of clean heating surface exposed to radiant heat.

Efficiency in stokered furnaces at above 200 per cent of rating might be secured, Mr. Armour felt, by using longer grates and clinker grinders but the return on extra investment might be questionable. Smaller combustion chambers for pulverized fuel were quite possible as a future development, which would bring the cost down equal to or lower than that for a stoker installation.

F. W. Dean, however, felt that the effect of radiant heat was over valued and that the high furnace temperature, however obtained, was the cause of rapid heat absorption. Also H. M. Burke felt that conditions were not enough different from ordinary to account for the results and credited a good mechanical stoker as the reason. He suggested that, for plants of this size, hand stokers might be found as effective and at lower first cost.

Free, rapid circulation was another point, brought out by Wm. G. Starkweather, due to large area for connection to the lower bank of tubes and rounded entrances and exits at headers.

Increase of evaporation at Corning Glass Works during a period of 3 yr. from 8 lb. up to 11½ lb. was attributed by Alfred Vaksdal to use of one kind of coal, firing by the same men, and use of recording instruments whose records were compared, discussed with the men and good work praised. Burning 20.7 lb. of coal, heat value 14,500 B.t.u., per square foot of grate, yearly averages for actual evaporation of 11.14 lb. and efficiency of 78 per cent were obtained, operating on the average at 141.3 per cent and with peak load 216 per cent of rating.

That good efficiency can be had with a fire-tube boiler was brought out by Alphonse A. Adler and John A. Stevens who cited results with h.r.t. boilers set 7 ft. and 9 ft. above the floor, giving smokeless combustion with bituminous coal and 14 to 16 per cent CO_2 with anthracite, carrying an incandescent fuel bed 1¼ in. thick.

THE BOSS told me, "It's not what I must pay my employes that worries me, it's how much they can earn for me balanced against what they cost me. They who produce the biggest earnings are inevitably going to get the most money; for there is competition in the labor market as in any other."

Diesel Crankshaft Should Be Protected

FAILURE RARELY DUE TO POOR MATERIAL BUT RESULTS FROM NEGLECT OF OTHER PARTS. BY J. J. McDOUGALL

ONE OF THE MOST expensive breakdowns to occur in the operation of a Diesel engine is that of crankshaft failure, the engine being out of service for considerable time and the cost of repairing the shaft considerable, whether it be of the built-up type with sections coupled together, or a solid forging.

Failures have generally been traced back to one or more of five causes: misalinement, fuel valve trouble, water in cylinders, excessive vibration, defective material. The plant owner or operator can, to a great extent, control the first three and, to some extent, 4 and 5 by refusing to accept the engine if these defects are in evidence during the erection or when the engine is started up.

Misalinement is the one most frequently met with and, although it will not always cause a shaft to break,

FIG. 1. WRISTPIN BEARING FAILURE CAUSED BY POORLY-ALINED SHAFT

may cause much bearing trouble, by throwing the connecting rod out of line and forcing the piston hard against one side of the cylinder wall. Rapid wear of the cylinder, piston and piston packing results and all or most of the pressure is thrown on one wristpin bearing causing it to fail rapidly. Such a failure of wristpin bearings of cast steel shells lined with babbit is shown in Fig. 1. Due to the fact that the piston was provided with a crosshead and considerable clearance allowed between piston and cylinder, the cylinder was not damaged a great deal but a trunk piston would no doubt have run hot and seized, damaging both piston and cylinder.

MISALINEMENT DANGERS COMMON TO BOTH VERTICAL AND HORIZONTAL ENGINES

In any case, misalinement sets up a bending strain in the shaft so that any extra strain may bring the total near the breaking point and any additional strain, such as a valve dropping in the cylinder, a connecting rod bolt breaking or a counterweight dropping off, may result in the shaft failing. Figures 2 and 3 show two of these incidents. Fortunately in these cases the shafts were in perfect alinement and no apparent damage to the shafts resulted.

In Fig. 2 the fuel valve falling inside the cylinder was punched through the head by the piston. The crack noticeable between the two ports had not yet opened up sufficient to leak water. Connecting rod failure must also be closely watched, Fig. 3 showing the effect of such a failure on a horizontal engine, the frame of which was later shrunk and pulled together with tie rods to give 10 yr. additional service. Connecting rod bolts should be measured frequently with a micrometer and, on heavy duty engines, it pays to renew them once a year regardless of their condition.

ALINEMENT EASILY CHECKED

In ordinary running the alinement of the shaft can be quickly checked by putting the crank on top dead center, measuring the distance between the webs with inside micrometers and then with the crank on bottom dead center measuring the distance again. If the measurements agree, the alinement is considered good. Engines in which the bearings are adjusted with wedges are easily alined but have a tendency to get out almost as easily, so must be kept always at their minimum running clearance. If allowed to pound, the wedges soon work loose and become dangerous. Engines using solid shims for adjustment are harder to adjust but once correctly adjusted remain that way longer and stand considerable abuse.

How often a shaft should be checked for alinement depends on the materials of the shaft and bearings, the speed, and on the condition in which they are maintained. If poor, dirty, lubricating oil is used with bearings wearing and burning out rapidly, alinement must be checked frequently if severe damage is to be avoided. Upon proper conditions it should be sufficient to check the shaft when the cylinder liners are renewed.

Damage resulting from fuel valve trouble depends on whether the cylinder heads are provided with safety valves, how the fuel pump is set and the type of fuel valve. Practically designed and properly maintained, no trouble will be experienced from this source but when neglected great damage can result to the engine.

FUEL EXPLOSIONS CAUSE SEVERE VIBRATIONS

In this connection it is necessary to discuss but one of the worst cases, that of an engine using air to inject the fuel. If the fuel valve, through some defect, should stick open, the fuel is delivered in practically one slug and a heavy explosion results. Indicating a cylinder of a two-cycle engine in which the piston rings were failing rapidly, going out the exhaust port in pieces, it was noticed that the heavy fuel oil stopped burning when the compression dropped to about 350 lb. and the light fuel stopped at about 275 lb. In this case the fuel was injected at dead center so it might have burned at lower pressure if injected well before dead center. It shows, however, that, in normal conditions, if the fuel be injected before dead center, it will fire when the compression reaches 350 lb.—considerably before dead center. If the air is saturated with fuel the resulting explosion is violent. Safety valves prevent great damage but, when not provided and the cylinder heads are tightened down solidly, something is liable to break. Figure 4 shows what a multi-cylinder head looked like after a fuel explosion. If the shaft is already over-strained it may be broken.

Indicating an engine with heavy pound showed a pressure rise from 525 to 850 lb. Engines in which the

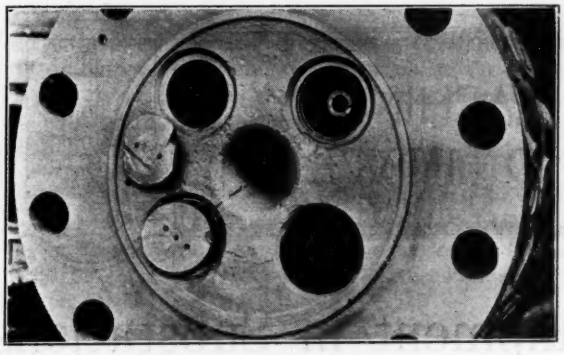


FIG. 2. BROKEN FUEL VALVE OF A VERTICAL ENGINE DRIVEN THROUGH THE CYLINDER HEAD BY PISTON

fuel valves were leaking showed maximum pressures up to 700 lb. but no attempt was made to indicate those in which the fuel valve stuck wide open as the chances of a wreck were too great, the entire engine vibrating heavily. Such explosions do the engine no good and should be avoided. Practical men avoid the heavy explosions by setting the fuel pump to deliver its charge when the power piston is on its power or exhaust stroke. Then, if the fuel valve sticks, the new charge will not only overload and foul the cylinder but will not strain the shaft.

Water from Jackets Causes Trouble

Starting the engine with water in the cylinders is most frequently met with in engines whose jackets are made of cast iron, particularly those of large size. Cracked cylinder heads, cracked liners and cracked piston heads are three sources of water trouble. Steel cylinder and piston heads with properly proportioned cast-iron liners have pretty well overcome this, although in engines using cast-iron jackets there is always the element of danger if the engine is forced to carry overloads. Results of water getting in the cylinder are quite similar to steam engine troubles with a slug of water, buckled connecting and piston rods, overstrained or broken shafts and broken cylinder heads.

Even though fairly large cracks develop in the cylinder heads and liners, the engine can be kept running because these cracks close up on heavy load or when hot, though it is often necessary to preheat the engine in order to start. It is always a good idea to turn the

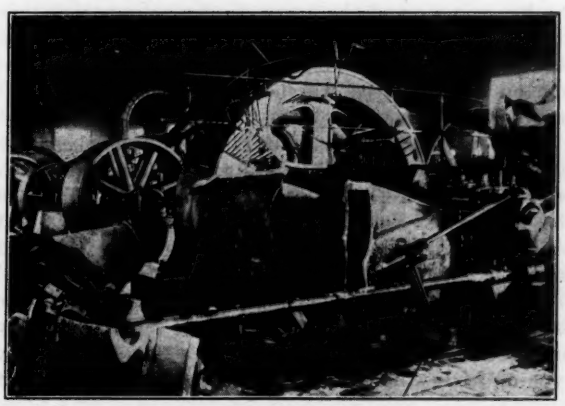


FIG. 3. THIS WRECK WAS CAUSED BY THE FAILURE OF CRYSTALLIZED CONNECTING ROD BOLTS

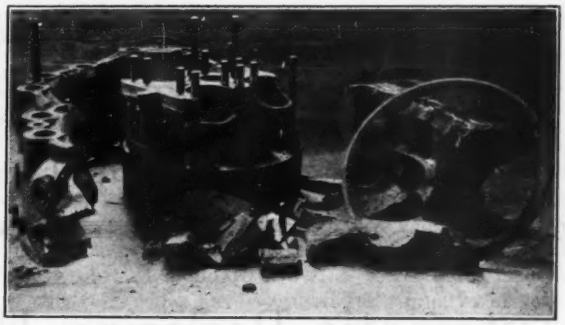


FIG. 4. FUEL VALVE TROUBLE FRACTURED THIS CYLINDER HEAD AND ENDANGERED THE SHAFT

engine over before starting up so as to make sure that no cylinder has too much water in it. An air motor geared to the flywheel is an easy method of turning a large engine. Built-up shafts are not so badly damaged from water as the solid types as the keys generally shear or the webs crack so repairs can be made without extracting the shaft—always a tedious job.

Critical Shaft Speed Must Be Avoided

Excessive vibration is dangerous and the owner of a plant should refuse to accept an engine until it runs smooth. When the engine is run at a critical speed, all parts of the engine vibrate in synchronism, so such speeds must be avoided. Vibrations may be caused by the driven machine being out of order or by unbalanced cylinders. Heavy vibrations have been greatly reduced by unbalancing the engine, that is, overloading some cylinders and underloading others, the damages resulting from the overload being cheaper than that caused by the vibrations. In many cases vibration is due to poor foundations and lightly constructed engines. In one particular engine a change of 2 deg. in the setting of the fuel valve made an enormous difference in the vibration of the entire engine; in another tying the cylinder together, drilling holes in the bedplate and filling it with grout helped considerably.

Either in the shaft itself, counter-weights, flywheel, connecting rod bolts or bearings, defective material, design and workmanship may cause failures, especially in old engines. For a shaft to fail from defects in the metal is rare as the factor of safety used is high. Figure 6 shows a crank failure of a built-up shaft. Inspection of the web showed the journal was improperly pressed in, causing an overstrain. It is doubtful if this alone caused the failure as considerable fuel valve and water trouble was undergone by this shaft, a case of both manufacturer and maintenance being at fault.

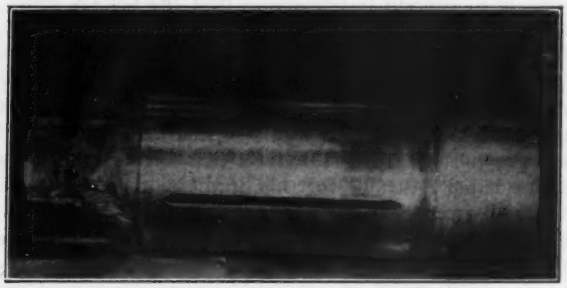
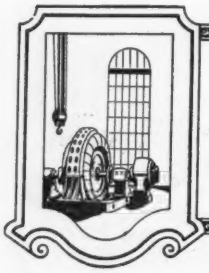


FIG. 5. THIS JOURNAL WAS NOT PROPERLY PRESSED IN THE WEB AND THE SHAFT FAILED IN SEVERE SERVICE



ELECTRICAL MACHINERY FOR LIGHT AND POWER

Automatic Reclosing Equipment in Substations

PART 2. CONSIDERATION OF DIFFERENT SCHEMES FOR RECLOSING ON MULTIPLE FEED AND ON COMBINED STUB END AND MULTIPLE FEED. OPERATION OF STANDARD EQUIPMENT. BY A. E. ANDERSON*

IN THE FIRST PART of this article which appeared in the October 15 issue, there was described the method by which various relay circuits, resistance values and relay calibrations are determined for load indicating on stub end feed. Continuing the discussion, we will now proceed to a consideration of different schemes for reclosing on multiple feed and on combined stub end and multiple feed. This will be followed by a description of the operation of standard equipment, and several paragraphs on the application of automatic reclosing feeders to manual and automatic stations.

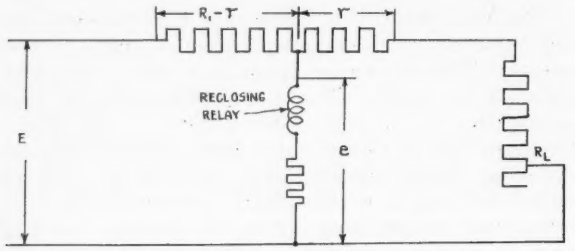


FIG. 1. A RECLOSING RELAY CONNECTED ACROSS A PORTION OF THE LOAD INDICATING RESISTOR

CONSIDERATION OF DIFFERENT SCHEMES FOR RECLOSING ON MULTIPLE FEED

Simulation of manual operation has the same disadvantages on multiple feed as has been pointed out in the discussion under stub end feeders where the same method of operation was considered.

Load limiting resistors are designed to "shift" some of the overload to a more distant station. Upon the occurrence of an overload, a section of resistance is inserted in the feeder circuit. This operation transfers a portion of the overload to a more distant station. A division of current is reached so that the voltage drops, in the feeders and returns to the two stations, are equal. This method of operation is satisfactory on multiple feed. In mining service, however, the substation may often operate on stub end feed. The disadvantage of a load limiting feeder on stub end feed has been pointed out previously, hence it follows that the load limiting feeder is not desirable for this application.

The load indicating resistor has no function on multiple feed. Since it introduces no complication in the operation of the equipment, it is left connected across the breaker contacts.

Generally speaking, it has been found impractical to determine by resistance measurements, from one station, the amount of load that may be picked up on multiple feed. The resistance between stations, the location and size of the load are some of the factors that determine the reclosing current. The problem is further complicated when a number of stations are considered as feeding a common load in multiple.

Two indications are readily available for determining external circuit conditions on multiple feed. Both are voltage indications and differ only in the place where they are obtained. One point where such a voltage may be measured is (a) across the load, another is (b) across the circuit breaker or line contactor.

A voltage indication across the load does not take into consideration any possible changes in bus or station voltage. With the relay coil connected across the circuit breaker contacts, the voltage difference between the machine and feeders must be within a definite value. This in effect is the same as equalizing the machine and feeder voltages. For this reason the connection across the circuit breaker is preferred. Such a relay has been called a voltage equalizing relay. The setting of this relay depends on the amount of resistance in the feeders, trolley and return between stations, the location and size of the load. The relay is usually set at 10 per cent of rated voltage, and may be adjusted to meet the particular service requirement.

By connecting the reclosing relay to the center of the load indicating resistor, a modification of the first method (a) may be obtained. With this connection it is necessary to set the relay at the *average* between the bus voltage and the lowest feeder voltage that it is desired to reclose on multiple feed. It may readily be shown that a relay setting which will give good operation on multiple feed will not give good operation on stub end feed and vice versa.

For example, assume that the circuit breaker may safely be closed on multiple feed on a difference of 20 v. In other words, referring to Fig. 1, E = 100, and since the drop across the load is assumed equal to 80 v. and r = 25, e will equal 90 v. Substituting these values in equation (17),† with $R_I = 50$, and assuming stub end feed, $R_L = 200$ ohms. Other values may readily be calculated. Due to the fact that this scheme has only one reclosing relay setting, it gives best results on one type of feed, which is usually multiple. This makes it

*General Electric Co.

†$R_L = \dfrac{eR_I - E_r}{E - e}$

more suitable for sectionalizing service. On stub end feed it has been pointed out that the load indicating resistor cannot be efficiently employed when the reclosing relay is connected to the center and adjusted to the maximum value that is consistent with variations in bus voltage.

Consideration of Different Schemes for Reclosing on Combined Stub End and Multiple Feed

For most mining applications a reclosing feeder should be capable of reclosing on either stub end or multiple feed.

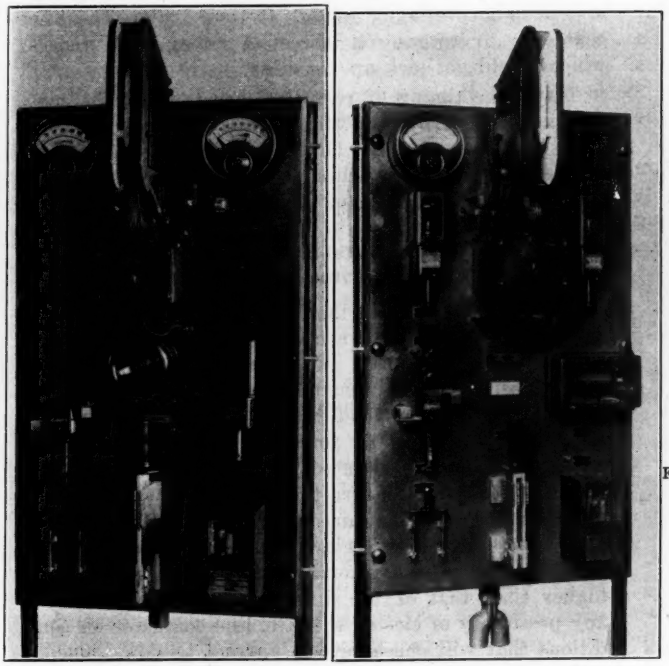


FIG. 2. SWITCHING EQUIPMENT FOR A D. C. RECLOSING STUB END FEEDER, 275 V., 1200 AMP.

FIG. 4. AUTOMATIC SWITCHING EQUIPMENT FOR COMBINED STUB END AND MULTIPLE D. C. RECLOSING FEEDER, 275 V., 1500 AMP.

Simulation of manual operation and load limiting resistor feeders has been considered and found to be lacking in some of the essential requirements. A load indicating resistor feeder can give the desired operation on stub end feed and by the addition of suitable (two) relays can be made to function correctly on multiple feed. As shown in Fig. 5, relay 183 (called a selective control relay) is connected across the load indicating resistor. On stub end feed practically normal voltage is obtained across the load indicating resistor, which picks up the selective control relay, 183, and allows the reclosing relay, 182, to close the circuit breaker or line contactor, 118, when external circuit conditions are satisfactory. Where the feeder voltage is maintained by some other source (multiple feed), there will be sufficient voltage on the feeder, with the usual amount of feeder copper, to keep the voltage drop across the load indicating resistor and the selective control relay, 183, below a value at which the latter operates. This removes the control of the circuit breaker or line contactor from the reclosing relay, 182, and gives the voltage equalizing relay, 160, control.

Description of Operation of Standard Equipment—Stub End Feed

Figure 2 shows a standard stub end reclosing feeder with voltmeter, ammeter, rheostat mechanism and line switch. This particular equipment is designed for use on the d. c. end of a 275-v., 200-kw. generator with a 2-hr. capacity of 300 kw. The line contactors which form a part of standard 275-v. d. c. reclosing feeders, are of a type which has been used for a number of years

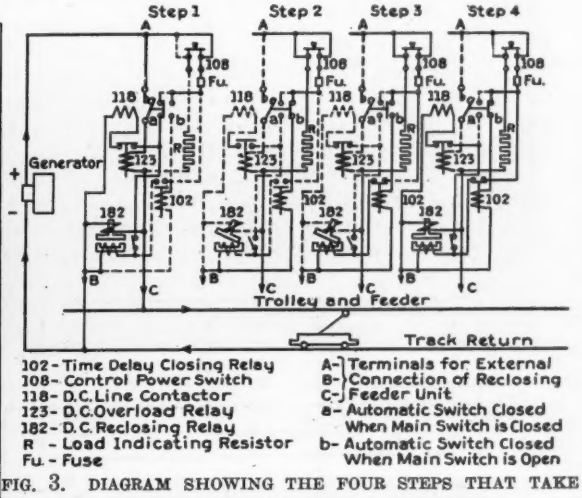

Step 1
Step 2
Step 3
Step 4
Generator
Trolley and Feeder
Track Return
102 - Time Delay Closing Relay
108 - Control Power Switch
118 - D.C. Line Contactor
123 - D.C. Overload Relay
182 - D.C. Reclosing Relay
R - Load Indicating Resistor
Fu. - Fuse
A-, B-, C- Terminals for External Connection of Reclosing Feeder Unit
a - Automatic Switch Closed When Main Switch is Closed
b - Automatic Switch Closed When Main Switch is Open

FIG. 3. DIAGRAM SHOWING THE FOUR STEPS THAT TAKE PLACE IN THE RECLOSING OPERATION

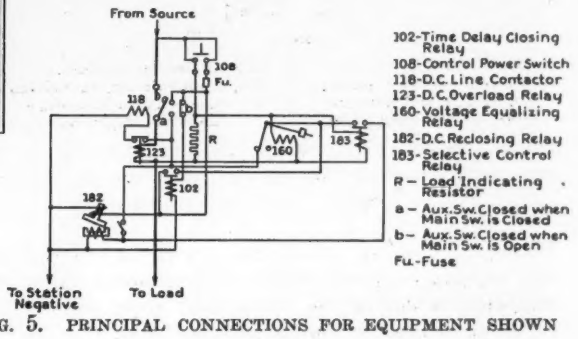


FIG. 5. PRINCIPAL CONNECTIONS FOR EQUIPMENT SHOWN IN FIG. 4

in industrial applications, such as steel mills, cranes, hoists, coal and iron bridges, etc. The relays used in these equipments have been standardized for a number of years for manual and automatic station application.

Device number plates appear on the front and back of the panel. The same device or function numbers appear on the wiring diagram and in the instruction books. This method assists in making references and in understanding the operation of the equipment.

Figure 3 shows the connections of the devices essential to the operation of a stub end reclosing feeder. This diagram shows the four steps that take place in the reclosing operation. Circuits that are de-energized or have no effect on the particular step under consideration are shown dotted; those which are essential to the particular step under consideration are shown solid.

Step 1 represents normal conditions. Line contactor,

118, has its coil connected in series with the contacts of overload relay, 123, auxiliary switch "a" on 118, fuse and blade 108, to point A. Upon the occurrence of an overload 123 opens its contacts which de-energizes the coil of line contactor, 118. The opening of this contactor removes the overload.

Step 2 shows the various circuit conditions after the line contactor has opened. The opening of the "a" auxiliary switch disconnects the lower coil and contacts of the reclosing relay, 182. The coil of the line contactor, 118, is also disconnected from the positive control bus. Time relay, 102, is connected to the positive control bus through a "b" auxiliary switch on the line contactor, 118. This relay provides a definite time delay in order that external circuit conditions may reach a settled condition. During this interval current flows through the load indicating resistor into the trolley circuit. As previously explained, this resistor limits the load indicating current to a small value.

Step 3 shows the additional control circuits that are energized after time delay relay, 102, has completed its timing. The lower coil and contacts of the reclosing relay, 182, are energized at full bus or station voltage.

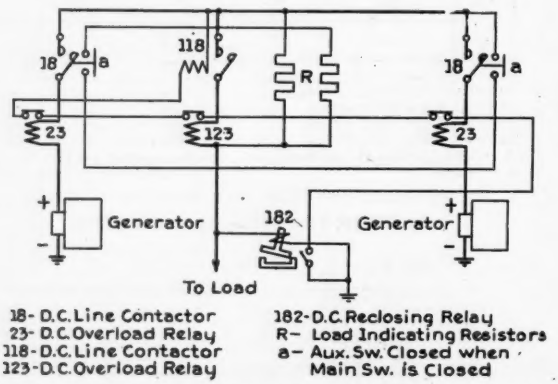


FIG. 6. TYPICAL CASE WHERE THE OVERLOAD AND RECLOSING CALIBRATIONS OF THE FEEDER DEPEND ON THE NUMBER OF MACHINES CONNECTED TO THE BUS

Under short circuit conditions or with an external circuit resistance of less than a predetermined value, the combined action of the upper and lower coils is not sufficient to close the contacts of this relay.

When the external circuit resistance has increased to a predetermined value, the reclosing relay, 182, closes its contacts which energizes the coil of the line contactor, 118. This condition is depicted in Step 4.

The line contactor then closes, restoring the connections shown in Step 1.

Description of Operation of Standard Equipment—Combined Stub End and Multiple Feed

Figure 4 shows a standard combined stub end and multiple reclosing feeder, with ammeter and line switch. The rating of this equipment is 275 v., 1500 amp.

Figure 5 shows the principal connections for such an equipment. It differs essentially from that shown in Fig. 3, in having a voltage equalizing relay and selective control relay in addition.

On stub end feed the step by step operation is practically the same as that given in connection with Fig. 3. As previously mentioned, the selective control relay, 183, transfers the control circuit to the reclosing relay, 182, on stub end feed. Under such circuit conditions the contacts of the voltage equalizing relay, 160, remain open.

On multiple feed, the voltage across the load indicating resistor is not sufficient to pick up the selective control relay, 183. This prevents the reclosing relay, 182, from having any control of the line contactor, 118. The voltage equalizing relay is of the contact making voltmeter construction, having its pick-up and drop-out voltages very close. Such a characteristic makes it suitable for this application. The ordinary plunger type relay, having a much greater difference between pick-up and drop-out voltages, would, at times, allow the line contactor to reclose on excessive voltage differences which would not pick up the relay.

After the timing of relay 102 has expired, the control is transferred to the voltage equalizing relay, which closes the line contactor, 118, as soon as the voltage difference between the machine and feeder has decreased below the drop out value of the relay (160).

Application of Automatic Reclosing Feeders to Manual or Automatic Stations

Generally speaking, there is very little difference between the d. c. end of a machine in a manually operated or automatic mine substation equipped with reclosing feeders. An automatic substation requires polarized, reversed current and voltage directional relays, in addition to those usually found on the d. c. end of machines in manually operated stations.

Polarized relays insure that the polarity of the incoming machine is the same as that of the d. c. system. The voltage directional relay makes it necessary for the d. c. voltage of the incoming machine to be slightly higher than that of the d. c. system. This precludes any possibility of closing the d. c. line contactor on conditions that will cause reverse current to flow immediately. The reverse current relay protects the machine against reverse currents once the machine is connected on the bus. The relay is usually set so as to take the machine out of service on currents from the maximum obtainable down to running light currents.

In manually operated stations it is usually the practice to omit the above set of relays; however, with the substitutions of automatic reclosing for manually operated d. c. feeders, it is sometimes customary to start the machine (from the a. c. end) and, once having determined the correct polarity, allow the machine to take care of itself. If a machine is allowed to operate in this manner, it is desirable to install the essential protective devices that are found in the automatic station. Once the machine has been started, polarized and "placed on the line," the protection afforded to the machine should be no different in an unattended (manually started) from that in a (completely) automatic substation.

Figure 6 illustrates a typical case where the overload and reclosing calibrations of the feeder depend on the number of machines connected to the bus. The feeder capacity is equal to the total of the two machines. In order to take care of single unit operation properly, an overload relay, 23, is provided in each machine circuit. The overload relay, 123, in the feeder circuit is set lower than the total settings of the two machine overload relays. In case either machine is overloaded, its

corresponding, 23, will open the line contactor. If an overload should occur beyond the feeder capacity, and less than the total machine capacity, on two unit operation, the feeder overload relay, 123, will open the line contactor, 118. The machine overload relays are usually set at the commutating capacity of the machine.

Reclosing calibration is varied as shown in Fig. 6, by changing the value of the load indicating resistance. With the same setting of the reclosing relay in the above example, the reclosing current on single unit operation is approximately 50 per cent of the reclosing current on two unit operation.

It is possible to lay out many other combinations along the same general line as that shown in Fig. 6. As the number of feeders and machines in a station increases the more thoroughly should the problem be studied, keeping in mind the protection that should be given to the machine, operating requirements and simplicity in the control scheme.

Conclusion

In practice, there may be a few unusual external circuit combinations where a load indicating scheme of the combined stub end and multiple feed type herein recommended may not give the desired range of operation. Such conditions would be due chiefly to improper sectionalizing, high resistance load or high resistance between stations. Once these factors have been removed, no difficulty should be experienced in obtaining the desired range.

Two Million-Volt Laboratory Opened by Stanford University

ON FRIDAY, SEPTEMBER 17, before an assemblage of eminent men of science, the highest voltage yet obtained by man was demonstrated in the new high voltage laboratory of Stanford University in California. A ribbon of living flame more than 20 ft. long leaped between two points high in the air above six giant transformers, marking the highest voltage yet attained at commercial frequency, 2,100,000 v.

This laboratory has been erected by Stanford University with the aid of a number of large electrical concerns of the Pacific coast and the nation, which initiated the enterprise in recognition of the contribution of Dr. Harris J. Ryan, to electrical science and industry, and to insure the continuing his research work which has outgrown the capacity of the high voltage laboratory building which the university erected in 1913. The laboratory is an immense structure with a steel framework covered with asbestos. The main building is 173 ft. long, 60 ft. wide, and 65 ft. high. It has an interior height of 50 ft. in the clear with no supporting columns.

For the production of high voltages six transformers of special design, the work of Allen B. Hendricks of the General Electric Company, were installed. Each of these six units is rated at 350,000 v. high tension, 2300 v. low tension, and weighs 22 t. They have been so designed and constructed that they may be used in every manner of connection for the whole range of voltages, single phase or three phase, up to 2,100,000 v. single phase, 1,200,000 v. three phase and lesser voltages.

The units are designed for the so-called chain connection. The first transformer is excited directly off the alternator. One end of the 2300-v. winding, one end of the 350,000-v. winding, and one end of the exciting primary winding are connected together and to the core and tank which in turn is grounded. One end of exciting secondary winding is connected to the line end of the main high voltage winding and to the main conductor of the high voltage terminal. The other end of the exciting secondary winding is connected to an insulated cable passing through the main high voltage terminal. The main conductor of the high voltage terminal is connected to the tank in the next transformer and the insulated cable passing through the high voltage terminal is connected to the end of the low voltage and exciting primary windings on the next transformer. When finally three transformers are connected in series in this manner, there will be 1,050,000 v. between the high voltage terminal and the third transformer and ground. When six transformers are connected in

FIG. 1. A 2,100,000-V. SPARK BETWEEN NEEDLE POINTS 20 FT. 1 IN. APART. THE LACE-LIKE APPEARANCE OF 60-CYCLE CURRENT IS APPARENT IN THE FLASH

FIG. 2. LOOKING LENGTHWISE WITHIN THE LABORATORY SHOWING THE BANK OF 6 TRANSFORMERS, AND THE 10-T. CRANE

series with the mid point grounded, there will be obtained 2,100,000 v. between outside terminals.

This new equipment is to be used by Professor Harris J. Ryan, and his assistants in the Electrical Engineering Department of the university, to determine the necessary facts for engineers to design equipment to handle the high voltages which will be needed in the near future when electrical power in the far west will have to be carried over long distances from its source, to the markets in cities hundreds of miles away. The laboratory will also be used by scientists and engineers of the electrical industry with whom Dr. Ryan has co-operated for a number of years in working out practical problems.

An interesting feature of the building is that it can be made lightproof without a ray of sunshine penetrating through its vast interior. For other uses, practically one whole side can be rolled away, utilizing three doors that are the largest ever constructed, so immense in fact that engineers were hard-pressed to devise their construction. They are each 47 ft. high and 40 ft. wide, but although they are entirely of metal they are mounted on rollers in such fashion that a single man can move them easily, opening a space 120 ft. long. A much smaller building of concrete has been built adjacent to the north side of the main building to contain the requisite power plant and voltage control facilities, offices and instruments, photograph, dark and seminar rooms.

Water Velocities in Hydraulic Turbine Plants

In Designing New Plants and Rebuilding Old Ones, Water Velocities Affect Pipe Lines, Sizes, Scroll Cases and Draft Tubes and Speed Regulation. By John S. Carpenter

IN THE INTEREST of good overall efficiency and good regulating qualities, the following velocity relations are offered for use in checking over projected designs of hydraulic turbine plants. As a rule, one finds more reasonable water velocities in new plants than in those that are to be reconstructed and to have new generating equipment installed. In the plant that is to be rebuilt, one finds great reluctance on the part of the owners to make any changes at all in the hydraulic cross sections. The removal of existing concrete is an expensive job and the use of dynamite involves some risks. In such cases, the best plan is to make model sized tests in an hydraulic laboratory, where a model of the actual turbine can be tested in relation to the forms and arrangements of existing hydraulic structures and definite results obtained. The test results then may be stepped up to the actual plant dimensions and head; thus assured results are obtained at a very reasonable cost, definitely indicating just what specific changes are required to attain the test results. The effect of contemplated changes may then be accurately predicted.

Data for New Plants

In the design of new plants, we have a large fund of data as to suitable velocities of flow that have been found by experience to be proper and economically advisable so that materials are not wasted by too conservative design. A warning is here sounded for the benefit of those who have not had experience in this class of work, to watch for the plant wherein everything is pushed to the limit; velocities as high as possible, guarantees high, skimped designs—they all lead to almost certain disappointment. Recovery in such cases is almost impossible without great expense in tearing out and rebuilding anew. Litigation is only to be instituted as a last resort, for it is hard enough to get a comparatively simple engineering case through our courts, let alone an involved one such as failure to realize, loss of use, loss of profits, and so on.

Trash racks should be designed of such areas that the maximum water quantity to be used by the plant does not have a higher velocity than about 2.6 ft. per second figured on the basis of net areas. A velocity of 2.0 ft. per second is better if it can be had. In figuring net areas, include all surfaces that obstruct the flow, such as cross tie rods, supporting structural work if any, as well as the area of the bars themselves. The loss of head caused by trash racks of insufficient size may be a large percentage of the total head in the case of low head plants, while for the higher head jobs the same loss may be insignificant.

Flow Lines, Flumes and Pipe Lines

In flow lines, flumes or pipe lines, in view of the greater investment involved, higher velocities are in common use. It is often found that the designer will apply the theorem of economic design to find the smallest diameter of pipe line that will make the total annual cost a minimum. In so doing, he is likely to forget that a high velocity so found may be satisfactory as far as economics go, but might later necessitate the use of a surge tank and relief valves to secure even passable commercial speed regulation, thus upsetting the intricate calculations. In general, commercially satisfactory speed regulation is understood to be a 2 per cent speed change with a 10 per cent load change. Therefore it is not wise to select pipe line velocities over 6 to 9 ft. per second even for short pipe lines, and jobs under about 40 ft. head are better governed if the pipe line velocity does not exceed 4.5 to 6 ft. a second.

Speed Regulating Requirements the Deciding Factor

In the case of pipe lines of moderate length, which might be said to include those under 500 ft. long, where surge tanks cannot well be placed, regulation requirements should dictate the velocity of flow in the pipe line. Many engineers fail to get a correct mental grasp of the enormous kinetic energy changes involved in starting or stopping the flow of water in a moderately long pipe line. The surplus energy liberated by reason of a deceleration must go somewhere and we usually find it creating a pressure rise within the pipe. Surge tanks of the proper dimensions cost money and where they can be avoided, it is better to do so. Also, surge tanks of the so-called simple type are likely to aggravate speed changes because they tend to keep the water from coming to rest as regards the new head level, often vibrating up and down for 10 or 20 min., therefore lacking those characteristics which make for "dead beat" regulation. Designs of tanks having a throttling device of

known characteristics are preferable, as the water column comes to rest much sooner and the extent of the surges themselves is greatly damped. In cold climates it is necessary to keep the water in the tank from freezing if the system is to function properly. A foolproof pipe line, therefore, as regards this particular point, is one having moderate flow velocities so that appendages are not required. All pipe lines should be checked for the worst possible case of simultaneous unloading of all connected generator units, as well as for the sudden "load on" condition, wherein the ability of the pipe to resist collapse is called upon.

The following approximate formulas give results close to the Allievi and Gibson formulas, for use within the usual ranges of practice.

Load Rejection

In the case of load rejection the pipe line velocity will be reduced from a higher value to a lower, because the reduced load demands less water to carry it. This causes a change in kinetic energy, often several millions of footpounds.

Let P_r be the pressure rise in percentage, L the length of the pipe line in feet, v the velocity change in feet per second, T the closing time of the governor in seconds, g the gravity constant, 32.2, H_o the normal head in feet before the change.

$P_r = (120\ L\ v) \div (T\ g\ H_o)$ = present pressure rise.

Load Increase

The case of load increase causes the water to be accelerated from a lower velocity to a higher velocity, because there is a sudden demand for more water to carry the load.

Let P_d be the pressure drop in per cent, the other letters as before:

$P_d = (80\ L\ v) \div (T\ g\ H_o)$ = per cent pressure drop.

The above formulas can be solved when the proper values of T are known. Practical considerations govern this point. T should not be less than 1.5 sec. and as a general proposition, not more than 7 to 8 sec. Conditions permitting, the time should be short, but the resultant pressure rise must not figure too high. In the case of the pressure rise formula above, it is noted that the constant is 1.5 times that of the pressure drop, so for pressure changes within the pipe line, the pressure rise will always be more than the pressure drop, other conditions being the same.

Governor Time as Affected by Load Increase

Obviously, the governor time cannot be less than that required to accelerate the column of water from a static condition to the maximum velocity corresponding to full load on the turbines. If the grade of the pipe is substantially uniform, the amount of acceleration in the time T is, theoretically:

$$a = HgT \div L, \quad a > v, \quad T_{min} = aL \div Hg$$

Actually, about 75 per cent of the above acceleration is nearer practice. If T so found figures too large, that is 10 sec. or more, an adequate surge tank, or a larger pipe diameter to give slower velocity, will be required to improve the conditions.

If the grade upon which the pipe is laid differs greatly along the profile, a "weighed average" can be substituted for the fraction H ÷ L as follows:

Weighted average grade $= (l_1g_1 + l_2g_2 + \ldots . l_ng_n \div L$ where the individual lengths and their slopes are denoted by l and g respectively with appropriate subscripts, and L is the total of lengths. Where there are dips in the line and the slope is negative, or up, the sign of that particular term is minus and would be subtracted in the numerator of the last given equation. Note that the slope or grade is equal to the sine of the angle that the pipe is laid on.

Pressure Rises and Drops—Good Practice

Good speed regulation in pipe line plants usually indicates a maximum pressure rise not exceeding 35 per cent of the normal head with full load thrown off. This means, for governors having equal opening and closing times, a pressure drop of about 24 per cent, which is within good practice. Governors are sometimes specially built to enable quicker closing than opening rates, to take care of a very long pipe line laid on a slight grade. This special feature is sometimes used when a fairly long canal carries the water on a nearly level profile, in which case there is not so much danger in quick closing but there is considerable time required to get the water accelerated to the required velocities.

Effect of Varying Sizes of Pipe Diameter

It is common practice, especially in the West, to divide the pipe line length into several sections of differing sizes, the diameters varying by 6-in. intervals; thus, for shipping by rail or boat, several sections of pipe can be telescoped within each other and full carload weights can be secured and much space can be saved in the case of marine shipping. The sections are commonly 10 to 18 ft. long, as suits the case in question. This practice makes different water velocities in each pipe size. For hydraulic computations we then use the "weighted" average velocity, figured as follows:

Weighted $v = (l_1v_1 + l_2v_2 + \ldots . l_nv_n) \div L$, to be used in the foregoing formulas directly.

Scroll Case and Draft Tube Influence

Sometimes, in figuring the regulation to be expected, the influence of the scroll case and draft tube is overlooked or neglected as inconsequential, which may turn out to be a source of trouble. The circumferential length of the spiral scroll case times its mean velocity should be added in the last given formula; and also that of the draft tube. These two elements are appreciable factors since the velocities are usually fairly high, though the lengths in themselves may be short, usually not over 30 or 40 ft. each.

Long draft tubes are rather a detriment to good speed regulation although necessary to good hydraulic efficiency. One of the cases to be watchful of is the plant layout in which it is necessary to carry away the discharge of the plant in a covered canal which virtually makes the draft tube consist of the total length of tube proper and canal. This type tends to surge greatly at each change of load and the effect on speed regulation can be extremely annoying to customers. The solution is suddenly to enlarge the cross section of the discharge conduit at the end of the draft tube proper and then to build a vent to the atmosphere at least as large in area as the draft tube areas, so that the length of the water column can be broken and the vent can act as a surge tank.

Length of Open Belts

IN THE October 15, 1924, number of Power Plant Engineering, pages 1067 and 1068, a ' Handy Arc of Contact Rule'' was published for determining the angle

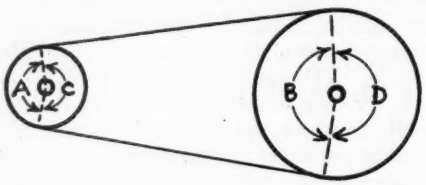


DIAGRAM SHOWING EQUALITY OF ARCS OF CONTACT A AND B AND C AND D

of belt contact on the small pulley. The following formula was developed:

$$180 - [58(D - d) \div L]$$

Where D = diameter of large pulley.
d = diameter of small pulley.
L = distance between shaft centers.

Referring to the accompanying figure, the foregoing formula gives the angle of contact A in degrees.

Since developing the preceding, I stumbled onto the fact that angle A is equal to angle B in the large pulley and that angle C is equal to angle D. This being the case, it is possible to use the above formula for determining belt lengths more accurately than is obtainable by means of any other empirical formula of which the writer has knowledge that does not involve the use of the angle, the sine of the angle, or the cosine of the angle.

I will not take up the space necessary to develop the formula but should any reader of Power Plant Engineering wish to do so, it can be rationally developed from the data given in the October 15, 1924, number. The resulting formula is this:

Length of belt, inches =

$$\frac{3.14L(d + D) + (D - d)^2}{2L} + \sqrt{4L^2 - (D - d)^2}$$

Where D, d and L are the same as above and where all must be in inches if the result is wanted in inches.

Applying this formula to a drive in which there is considerable difference in diameter and in which the distance between shaft centers is short, namely: D = 50 in.; d = 10 in.; L = 60 in.; it will be found that the length of the belt is 220.5 in.

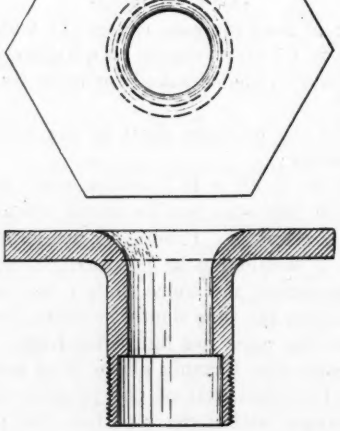
Applying the "exact" formula, with trigonometric functions, I get 220.6 in. as the "exact" answer. In other words, the difference is only 0.1 in.

For belted pulleys with the arc of contact on the small pulley varying from 180 to 120 deg., this formula will give quite accurate results. It is seldom that we have an arc of contact on the small pulley smaller than 120 deg.

Newark, N. J. W. F. SCHAPHORST.

Orifice Tests for Rotative Dry Vacuum Pumps

IN A RECENT article, Robert R. Walden, under the above heading, gives the details of a good method for checking the performances of hydraulic vacuum pumps and steam and water jet air ejectors. The writer has tried it several times on rotative wet and dry vacuum pumps, but it has not proved so suitable for this type



TEST NOZZLE

of equipment due to the pulsating nature of the air flow through the pump causing unstable mercury column conditions. As long as the minimum vacuum at the suction to the air pump does not fall below 15 in. referred to a 30-in. barometer, the capacity of an orifice of the general type mentioned by Mr. Walden will not vary, hence the air load on the pump through say a ½-in. orifice will be the same, 247 lb. per hr. dry air at 70 deg. F. whether the vacuum is 16, 26 or 29 in., but the satisfactory damping of the mercury column fluctuations is virtually impossible.

One of the most satisfactory methods of damping pulsations of this sort which we have observed, when a U-tube is used, is to heat a small portion of one leg of the U-tube and pinch the glass tubing almost together. In doing such work as this, a smoky or yellow gas flame must be used for heating the glass and the tongs used

to pinch the tube should also be hot. After pinching, the tube should be thoroughly annealed by withdrawing it very slowly from the flame, to prevent cracking.

A type of orifice for this work which the writer has found more satisfactory than the washer type shown by Mr. Walden is shown in the attached sketch. This plug type orifice is commonly made with a ¾-in. pipe thread and excepting for the bore, there is no great accuracy needed for its successful fabrication. The radius at the inlet end of the orifice should be extremely smooth and if turned to a radius equal to the diameter of the orifice, will give proper inlet stream lines and result in uniform performance. The accompanying table gives the capacities in pounds of free dry air per hour, at 70 deg. F. of plug orifices of the type described. The falling coefficient of discharge, shown on Fig. 2 of Mr. Walden's curve, is not a characteristic of the well rounded orifice similar to this plug type.

CAPACITIES OF BELL MOUTHED TEST NOZZLES LBS. FREE DRY AIR 1 HOUR AT 70 DEG. F. WHEN PRESSURE RATIO IS ABOVE CRITICAL

Orifice drain inches	Lb. air per hr.	Orifice drain inches	Lb. air per hr.
1/16	3.87	5/16	96.6
3/32	8.70	11/32	116.7
1/8	15.45	3/8	139.0
5/32	24.1	13/32	163.0
3/16	34.8	7/16	189.2
7/32	47.3	1/2	247
1/4	61.8	9/16	314
9/32	78.2	5/8	386

An accurate method for applying tests of this nature to the checking of rotative dry and wet vacuum pumps has been discussed in the Proceedings A. S. M. E., 1921, Vol. 43. This makes use of similar orifices to the plug type and handles capably the methods of their application and the interpretation of their readings.

Jeannette, Pa. CHARLES E. COLBORN.

Installing Water Glasses

RECENTLY I OBSERVED one of the firemen in a power plant install a new water glass on one of his steam boilers. The things he did which he should not have done, and the things he did not do which he should have done tempts me to offer the following suggestions regarding water glass installation.

Do not permit the glass to turn during installation, nor put new washers on old ones. Hold the glass with one hand while tightening the gland or packing box cover. You can tell by the "pull" when the washer is sufficiently tight. When the glass is allowed to turn with the nut, the overtightened packing may exert excessive pressure on the glass. Overtight packing will also prevent free lineal, as well as external expansion. This conditions will tend to cause glass breakage. Since there are so many inexpensive, efficient and safe gage glass washers on the market, the custom of using lubricated hemp or asbestos around glasses is inexcusable.

It is often necessary to remove a broken glass and install a new one in a few seconds' time. When time permits, steam and water should be blown through the mountings to make sure no old packing or broken glass had been overlooked when the fittings were cleaned. Most glasses will give good service if they are installed properly in properly alined fittings and when they receive intelligent care.

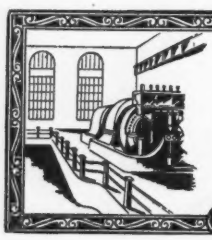
In the case in question, after the man installed the glass he at once opened both cocks wide, the drip cock being closed. Since doors, which were wide open to the outside cold air, were directly in front of the boiler, it was strange that the glass did not break; even a high grade well tempered glass could hardly be expected to survive these conditions. A good glass will withstand a lot of abuse but some careless men greatly overdo the matter and then complain about the poor quality of the glasses.

Toronto, Canada JAMES E. NOBLE.

Power Companies Use Tractors in California

HYDRO-ELECTRIC power companies are finding Caterpillar tractors of great value in the construction and maintenance of transmission lines, dams, and in hauling supplies. This is especially true in California, where one company has installed a high tower on a Caterpillar tractor which was used in stringing 50 mi. of power transmission wire and in raising poles, doing the work quickly and economically. This outfit, shown in the photograph, carries a substantial tower at the top of which was a working platform and a heavy cross-piece. This cross-piece carried six sheaves which with cables operated by a winch on the Caterpillar were used in raising the transmission wires from the ground. The winch is controlled from the tractor driver's seat. This equipment traveled over steep grades and through rough country.

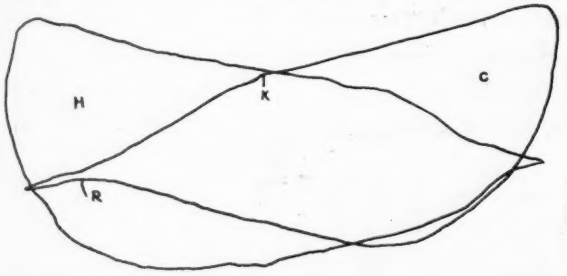
San Francisco, Calif. C. W. GEIGER.



QUESTIONS AND ANSWERS

Faulty Valve Setting

I AM SENDING you an indicator card from a four-valve non-releasing gear, 16 by 30-in., 160-r.p.m., throttle governed engine. There is a knock in the crank end. I have given it more compression but cannot overcome the knocking. The point of release indicates that the exhaust eccentric has slipped. Since it involves considerable work to adjust this by trial because of the difficulty of raising the main bearing every time I want to move the eccentric, I would be pleased if you would suggest how much I should move the eccentric in order



SHOWING EFFECT ON STEAM DISTRIBUTION CAUSED BY SLIPPING OF EXHAUST ECCENTRIC

to adjust it properly and I would also be glad to receive any other suggestions you may give me. G. B. R.

A. Your exhaust eccentric has undoubtedly slipped. As shown in the figure, release occurs at R, which is on the exhaust stroke instead of being, where it should be, on the expansion stroke so as to have the exhaust ports open during the slow movement of the piston, i. e., at the end of the stroke instead of, as in your case, too late and during the fastest movement of the piston.

Your cutoff seems to be late but this will probably be rectified when you reset your valves, because of the better distribution which will result. The gradual drop of the exhaust line indicates possible restriction in the exhaust ports or passages, but this also will probably be corrected when the valve is reset because in that case, the exhaust port being wide open during the slow movement of the piston, will cause the pressure to drop rapidly at that point and reduce the quantity of steam that must be passed through the exhaust ports during the short time of the exhaust stroke.

The openings of your steam ports do not occur at the same relative positions of the stroke. At the crank end, the admission is a little early; at the head end, a little late. This would also be properly balanced in resetting the valves.

Instead of trying, therefore, to overcome your difficulty by a trial and error adjustment, we would strongly advise that you reset the valves in the regular way, going through the process step by step. The methodical resetting of your valves would not take long and would repay you well.

Smoke Abatement and Determination of Amount of Dust in Air

I WOULD LIKE to purchase from you, reprints of the latest publications you have on smoke abatement, especially any you may have dealing with methods of measuring the amount of dust in the air in the vicinity of factories. Your publication "Smoke Problem in Salt Lake City," August 15, 1920, would be gladly received whether or not it deals with this phase of the subject.

J. H. R.

A. Serial 2341, April, 1922, of the Bureau of Mines, Washington, D. C., gives a later and more complete report on "Smokeless Fuel for Salt Lake City" than the article published in the August 15, 1920, issue of Power Plant Engineering. It would be better, therefore, for you to refer to this report.

The Bureau of Mines issues a list of its publications including those on smoke abatement and allied subjects, which may be obtained without cost. We believe that this would assist you considerably.

Among the principal publications of the Bureau of Mines, that deal with the smoke question are the following:

Bulletin 40 on "The Smokeless Combustion of Coal in Boiler Furnaces" by Randall and Weeks, 1918.

Bulletin 49 on "Smoke Abatement and City Smoke Ordinances" by Flagg, 1912.

Technical Paper 80 on "Hand Firing Soft Coal under Power Plant Boilers" by Kreisinger, 1915.

Bulletin 39 on "The Smoke Problem at Boiler Plants" by Randall, 1917. This contains a rather extensive bibliography.

Technical Paper 97 on "Saving Fuel in Heating a House" by Breckinridge & Flagg, 1917.

Technical Paper 137 on "Combustion in the Fuel Bed of Hand Fired Furnaces" by Kreisinger, Ovitz and Augustine, 1917.

Bulletin 135 on "Combustion of Coal and Design of Furnaces" by Kreisinger, Augustine and Ovitz, 1917.

Technical Paper 273 on "Smoke Abatement" by Monnett, 1923.

Technical Paper 338 on "Smoke Abatement Investigation at Grafton, W. Va." by Monnett and Hughes, 1924.

The above publications may be obtained at a nominal cost.

The Engineering Experiment Station, Urbana, Ill., has issued two excellent publications on this subject. They may be obtained at a nominal cost.

Bulletin 15 on "How to Burn Illinois Coal without

Smoke" by Breckinridge, 1907, and Bulletin 31 on "Fuel Tests with House-Heating Boilers" by Snodgrass, 1909.

The Iowa State College issues Bulletin 33 on "House Heating Fuel Tests" by Meeker and Wagner, 1913.

The City of Baltimore, Md., published very interesting articles in its Baltimore Municipal Journal as follows:

"Effects of Smoke upon Health" by Kehler, January 26, 1923.

"Effects of Smoke upon Property" by Kehler, June 8, 1923.

The Mellon Institute of Pittsburgh, Pa., published a series of bulletins on various phases of the smoke question including health and destructive influences. These bulletins are the result of an extensive investigation which was made at an expenditure of $40,000.00. Copies of these bulletins may be obtained at a nominal cost.

The proceedings of the International Association for the Prevention of Smoke may be obtained from the Publicity Director, 1410 City Hall Square Bldg., Chicago, Ill.

Concerning smoke measurements, the method most commonly employed for detection of city ordinance violations is the Ringelman Chart which is based upon the degree of density of shade. Although definite and accurate, the Ringelman method has a number of objectionable features in application. A smoke meter that embraces all of the advantages and avoids the disadvantages of the Ringelman method was illustrated and described in The Engineer (Chicago), February 1, 1908, page 180.

Smoke indicators that operate electrically, ringing a bell and causing a lamp to be illumined when smoke reaches a certain density, are described in The Practical Engineer in its April 15, 1914, issue, p. 469, and May 15, 1915, issue, p. 492. An optical smoke indicator of simple design was described and illustrated on p. 312 of the April, 1911, issue of the Practical Engineer. This latter enables a fireman to observe the smoke conditions of his boiler while he is firing the boiler, just as he may observe his steam gage to see his pressure conditions.

Originally smoke and dust survey work was carried on through the use of gelatin coated discs that were distributed throughout the district being investigated.

A better method is that described fully in the Bureau of Mines Technical Paper 338, mentioned above.

Transposing Formulas

CAN YOU give me a rule for the transposition of formulas? J. L. W.

A. In transposing a formula we must always remember that in order to maintain equality, if we remove a factor from one side of the equation, we must change its sign when it is added or subtracted to the other side. Or, if the factor removed from one side divides or multiplies the other factor or factors on that side, it must do the opposite when transposed to the other side of the equation; that is, if it divides the factor on the side from which you remove it, it must multiply the factor on the other side when it is transposed. For example, suppose we have the equation

$$X + Y = A + B$$

If we want to find out the value of X we must transpose Y to the right side. Since Y is added on the left side, it must be subtracted on the right side. The equation will then appear as

$$X = A + B - Y$$

Suppose we give numerical values to these different factors as follows:

$$A = 5$$
$$B = 2$$
$$X = 4$$
$$Y = 3$$

Substituting these values, we would have in the original equation

$$4 + 3 = 5 + 2$$

which is an equality. In the transposed equation we would have

$$4 = 5 + 2 - 3$$
$$= 7 - 3$$
$$= 4$$

which is also an equality.

Likewise let us assume the equation

$$\frac{X}{Y} = \frac{A}{B}$$

To find the value of X we must transpose Y. Since Y is divided into X on the left side of the equation, it must multiply the quantity on the right side when we remove it. The equation will then appear as follows:

$$X = \frac{AY}{B}$$

substituting numerical values for these factors as follows:

$$A = 16$$
$$B = 2$$
$$X = 32$$
$$Y = 4$$

our first equation would appear as

$$\frac{32}{4} = \frac{16}{2}$$

that is 8 = 8, which is equality.

And in the transposed equation our values would be:

$$32 = \frac{16 \times 4}{2}$$

which means 32 = 32 which is still an equality.

An Engine Piston Question

AN EXAMINATION question was put to me recently that seemed to me to be improper in an engineer's examination for license because of its indefiniteness. It is this: "What would you do if, after you had taken off the follower plate of the piston of a large cross compound steam engine and had adjusted its alinement, you had only 15 min. to start up but found difficulty in replacing the follower plate?" What would you do in this case? C. L. P.

A. The above question does seem to be poor for examination purposes since it is not clear nor complete.

Possibly the trouble was caused by a broken piston ring, part of which may have formed an obstruction. In this case, the obstructing piece should be removed and soft packing inserted temporarily until a more convenient time would permit replacing the broken piston ring.

EDITORIAL COMMENT

The Great Drama of Power

Several months ago we published a more or less detailed account of the new hydro-electric plant at Isle Maligne on the Saguenay River, Quebec, Canada, designed for an ultimate capacity of approximately half a million horsepower. It was with much interest, therefore, that we noted in the October issue of the Review of Reviews, an article dealing with the new empire of the Saguenay, an empire based on the power development of the region.

In writing this article, its author sensed behind the dry technical facts and descriptions an intensely dramatic story and he has, it seems to us, brought this drama to the fore and given it emphasis in a way that should attract the attention of the non-technical readers he is addressing. He gives an interesting picture of the normal, secluded agricultural life of the region and tells how for years it was pronounced impossible to harness the power of the great "deep mysterious river." He then describes in some detail the actual building of Isle Maligne, changing the involved technical data into a terse, vivid picture of action. He refers to the new developments at Chute-à-Caron and tells how the growth of the pulp and paper industry and the introduction of great aluminum industries are gradually changing the entire character of the region. Throughout the article, however, the writer skillfully keeps to the fore the essential drama of the subduing of this great stream.

It is this emphasis on the drama of the work that is not only interesting but, it seems to us, is of great value to the power industry. We have often mentioned the desirability of attempting to bring to the attention of the non-technical world the important developments in power generation that affect so vitally all our activities. It is a difficult thing to do. But it may be that, in addressing the layman, our many attempts to translate technical into non-technical terms are of little value unless we appeal to his love of the dramatic. Instead of constantly preaching to the layman that he ought to be interested in power, why not make him take an interest by appealing to the emotion that is easiest to play upon—his innate love of drama? And there is no greater drama in the world than the drama of power development.

Power Plant Waste Elimination

"Progress in Waste Elimination" was the major theme of the three hundred odd meetings that were held throughout the U. S. and Canada during 1926 "Management Week"—October 25 to 30.

While the study and practice of waste elimination has been more highly developed in manufacturing industries where standardization and simplification of methods, materials and equipment has wrought such beneficent effects, there is a great need for the application of many of these principles, so strongly advocated by the industrial engineer, in power plant practice.

We are reminded that the power plant of a certain large manufacturing establishment whose organization and manufacturing methods are often held up to us as examples par excellence, is, when measured in terms of these same standards, in a deplorable condition.

One of the speakers at a dinner meeting held in Chicago by various local engineering and management associations—a banker—in describing his attitude when surveying an industrial establishment with a view to possible extension of credit, indicated that he gets his first impression from the general condition of affairs. If things are slovenly and dirty and there is a lack of orderly arrangement, the impression is bad because such conditions are conducive to wasteful methods, lack of control and inefficient performance on the part of the employes. A dirty and disorderly condition of a plant is indicative of the character of the management and is sure to create waste because no working force can operate with high efficiency under such conditions.

The effect of proper maintenance of power houses and equipment and of proper conditions of working in such power houses has not been thoroughly appreciated by those who control their operation and great waste has resulted. In many instances the latent powers of the average employe have not been allowed to develop and function. Many power plant owners fail to recognize the fact that all men, whatever their station in life, have been born with certain fundamentally similar inherent tendencies, hence they have similar motives for action, similar desires and similar needs which, if permitted to develop properly, would greatly increase their efficiency.

In considering the power plant, let us not disregard the importance of preventing the "intangible" wastes as well as those that are perfectly obvious.

Flow of Information Is Essential to Progress in Industry

Investigations and research carried out by the American Library Association show that through the improvement in reorganization and in productive methods rendered industry by technically trained men, marked increases in industrial efficiency have been brought about. Production per wage earner employed has advanced at least 25 per cent during the past 10 yr. The conclusion drawn is that a great trend is taking place—the flow of technical knowledge, from the engineer and scientist to business and industry. Scientists have made discoveries which engineers have applied in industry to increase production, reduce costs and increase efficiency.

Recognizing the fundamental importance of scientific investigation, many of the large industrial concerns have

established laboratories. Other laboratories are maintained by the United States Government, large universities throughout the country and technical societies cooperating with government, university and private laboratories.

Discoveries made in industrial laboratories usually find direct application to the industry but a vast amount of valuable technical information obtained in scientific laboratories still remains buried in brochures, locked in laboratory reports and standing on shelves unknown.

To those engineers who do not have a research laboratory at their disposal, the scientific libraries located in the large cities throughout the country should prove of inestimable value in solving problems of the industry. The late Professor Jaques Loeb stated his belief that most scientific discoveries are made in libraries and then tested out in laboratories. In the power plant field a great amount of investigation has been done in laboratories but there is seldom a large or important new plant designed which does not include some feature which is more or less experimental. These plants become, in fact, laboratories for the investigation of new principles, applied to the industry at the same time, in most cases, paying good dividends on the investment.

By keeping informed on these investigations through the technical press, engineering societies and libraries, engineers have placed the power plant industry among the front ranks of the country and must be given considerable credit for advancing the production power of the wage earner.

Off Duty

With the possible exception of the numerous discourses on theory of "Service," no theme has been more overworked than that of success. Long-winded captains of industry sing it to the tune of dessert at banquets, university presidents grow eloquent over it at class reunions, Rotarians and Kiwanians while away valuable mid-day hours with it and preachers throughout the land shout it from the pulpits. The theme is, in fact, the mainstay of several weekly and monthly periodicals.

Yet few of the distinguished gentlemen in any of these groups have ever succeeded in defining success. It has remained for a biologist to point it out.

To the biologist success is no mystery. He, in his study of living things, has found out what success is and is secretly amused at the primitive attitudes of mind in regard to this subject displayed by the public generally. In a recent article in the Scientific Monthly, Prof. A. S. Pierce of Wisconsin gives the biologist's idea of success and asks us to consider two examples, the housefly and the dandelion.

From a biological viewpoint the survival of a species of animal in the struggle for existence may be considered as evidence of a certain level of success. That the housefly and the dandelion are successful cannot be doubted by anybody who has swatted flies or tried to keep a lawn neat. They have won many victories over the human race. In spite of all man has done to eradicate them, they survive. "They have," as the professor puts it, "beaten old Homo Sapiens himself."

From observing these two extraordinarily successful specimens of success, Prof. Pierce deduces that the first principle in attaining success is to be specialized, yet versatile. Our enemy, Sir Fly, with his skeleton on the outside of his body, his muscles within, his powerful fast moving wings, has a highly specialized physical equipment. He is small, alert and agile. Yet he has kept his versatility. Unlike the bee who must have sugar or perish, the fly can eat almost anything and thrive. His larvae, too, live on a wide variety of foods under great variations of temperature and moisture.

So, too, is the dandelion perfected and versatile. At one time Baron Dandelion was dependent upon cross fertilization for reproduction and developed a beautiful golden flower but he learned the secrets of self fertilization and the flower is now only an adornment.

Being specialized and versatile, both the fly and the dandelion are well fit for the struggle for existence. This struggle, says Prof. Pierce, is the second great essential of success. "There is no greater biological sin than to cease to struggle. It is not wrong to have a billion dollars or a presidency or a title but the unpardonable sin is in saying, 'I have done enough' or 'I have earned a rest'."

To cease to struggle is to become a parasite. There is plenty of biological evidence for this point of view, the barnacle and the tape worm being excellent samples of organisms that ceased to struggle. They live easy, comfortable lives but at what price? At the price of degeneracy—an inability of appreciation. And so, Prof. Pierce again concludes that the degree of ability and appreciation that any living thing possesses is proportional to the amount of struggling the organism has done. Lack of struggling is always associated with degeneracy, loss of power and lack of appreciation.

Another damnable biological sin, this biologist tells us, is deceit. Deception is practiced by spiders that spin delicate webs that are overlooked by careless insects. A walking stick is camouflaged in form and color to resemble a twig and thus escapes detection. Such means of securing a living are expedient but dangerous because the animals employing them are led to depend upon more and more special means and, if the deception is discovered, the game is up. If an actress who depends upon a $10,000 gown to win her audience loses her trunk, she loses her audience too.

One means of struggling and one that is used by many organisms, including men, ants, and termites, is through co-operation between many individuals. This, our biologist says, is one of the best means of attaining success if it does not involve too great a sacrifice of individuality or waste of effort on social parasites. Communism, for instance, tends to reduce all to the same level of mediocrity and makes the development of outstanding individuals more difficult. Again, social life is always associated with parasitism. No two individuals are ever of equal ability and some members of any community are abler and do more work than others. Furthermore, real social parasites intentionally insinuate themselves into communities where they make no attempt to do anything but make a living for themselves.

Finally, summing the matter up, the professor restates the message of biology concerning success. "Success is continued improvement. It is sinful to be narrow, lazy (or even contented?), deceitful or blindly co-operative."

Thus it is seen that success is not a goal to be reached or something to be looked forward to but is something that must be enjoyed in a process that must be maintained continuously.

Power Plant Equipment Exhibit, Dec. 6-11

WHY MEN WILL LEAVE HOME TO ATTEND THE EXPOSITION OF POWER AND MECHANICAL ENGINEERING AT GRAND CENTRAL PALACE IN NEW YORK

LEADERS of thought and action in the power plant field know that at this Power Show they will find assembled under one roof the outstanding mechanical achievements of the year. Progress and developments are startlingly rapid, and such men appreciate the importance of keeping in touch.

Analysis of the attendance last year showed that men came from forty-three states of the union and from twenty-three foreign countries. Of executives there were over five hundred presidents, nearly three hundred vice-presidents, over a thousand from sales departments, and over three hundred from purchasing departments. A hundred and fifty construction engineers came, over eight hundred factory and plant managers, over seven hundred superintendents, more than one thousand operating engineers, and some thirty-four hundred engineers of various classifications. These are busy men and they do not give up their home affairs and their time unless they feel that the result will be worth while.

FIG. 1. A VIEW OF THE MAIN FLOOR TAKEN FROM THE MEZZANINE DURING THE 1925 SHOW

Exhibits may be classified as new inventions, new processes and new ideas, improvements on old or tried principles, and engineering staples. So far as the range of products covered is concerned, it goes from the simplest of minor accessories up to full sized power generating equipment, so that there is food for thought and investigation for every man in the power plant field.

The engineering or trade exposition is a dramatization of progress in the field and gives a picture which everyone can understand of what is going on in the industry.

In the directory which follows will be found the chief details of the exhibit, showing where each booth is to be found and enabling our readers to plan in advance how they may spend their time at the show to the best advantage. As to the location of booths, Nos. 2 to 201 will be found on the main floor, 201 to 347, on the mezzanine or second floor, 401 to 575 on the third floor, and the numbers from 601 upward will be on the fourth floor. It is notable that this is the first year that the fourth floor has been used for exhibition purposes. Visitors can reach the Grand Central Palace, which is located on Lexington Avenue between 46th and 47th Streets, either by the Lexington Avenue surface line, the east side elevated or the east side subway. The Show will be open from December 6th to 11th, inclusive, from noon until 11 o'clock in the evening, and during this week a program of talks and motion picture exhibitions will be given covering the latest progress in the power plant field.

SUMMARY OF EXHIBITS

ACCURATE BRASS CASTING CO., INC., Cooper and Wykoff Aves., Brooklyn, N. Y. Booth 465; Third floor.

Brass and copper forgings and castings will be shown, also the method of casting to close dimensions will be demonstrated.

ACKERMAN-JOHNSON CO., 625 W. Jackson Blvd., Chicago, Ill. Booth 423; Third floor.

In this booth will be found a display of steam specialties handled by this organization, interestingly arranged for the benefit of visitors.

ADVANCE ENGINEERING CO., 168 Washington St., New York, N. Y. Booth 274; Second floor.

This company will display the line of products of the A. W. Cash Co. of Decatur, Ill., and of the Armstrong Machine Works of Three Rivers, Mich.

AERO PULVERIZER CO., 90 West St., New York, N. Y. Booths 319-20; Second floor.

A complete Aero unit coal pulverizer will be shown illustrating the construction and method of action, also parts of the pulverizer as they appear after having been a long time

in service to show the durability of construction. Photographs and drawings of installations and parts will be included.

AHLBERG BEARING CO., 317 E. 29th St., Chicago, Ill. Booth 693; Fourth floor.

Details of construction of bearings and their application for power and industrial machinery.

AIR PREHEATER CORP., 25 Broadway, New York, N. Y. Booths 234-5; Second floor.

Here will be found an exhibit of the Ljungstrom air preheater, and of the Howden air compressors with other apparatus for forced draft systems. A demonstration of the regenerative system of air heating as applied in this air preheater will be given.

AIR REDUCTION SALES CO., 342 Madison Ave., New York, N. Y. Booth 474; Third floor.

The Airco oxygen and acetylene cylinders will be exhibited, also the Airco Davis-Bournonville hand welding and cutting apparatus and supplies, for welding operations, such as rods, fluxes, goggles, etc. An exhibit of National carbide will also be made.

AJAX FLEXIBLE COUPLING CO., Westfield, N. Y. Booth 462; Third floor.

Here will be found a full line of Ajax couplings, showing the construction and the uses for driving shafting and direct connected machinery.

ALEXANDER BROS., 14 South St., Philadelphia, Pa. Booth 422; Third floor.

In this exhibit will be shown the Tentacular belt of special design to give efficient transmission. A sample belt will be shown in operation on a blower driven from an electric motor with very short centers and high pulley ratio.

A. ALLAN & SON, Harrison, N. J. Booths 483-4; Third floor.

This company will feature applications of Allan red metal, including labyrinth packing rings for steam turbines, red metal piston rod and valve steam packing rings for locomotive, marine and stationary engines, Allan metal faced pistons for steam engines, air compressors and pumps.

ALLEN & BILLMYRE CO., INC., Grand Central Palace, New York. Booths 491-2; Third floor.

Effort has been made to make this exhibit of great interest to power plant engineers, and a 10-hp. heavy duty pneumatic sweeping system will be shown for use in power plants for removing coal siftings from beneath stokers and for general cleaning, including floors, walls, overhead piping, and boiler tops. Dust collectors with special dumping bottoms will be shown for rapid disposal of accumulated coal and dust, these separators frequently being located above the bunkers in the boiler house so that the collected material can be readily put into the coaling system. A 5-hp. blower exhauster will be in constant operation showing the quiet operation of Tabco units for such purposes as aeration of water in ice plants, pneumatic tube systems, etc. There will also be a 5-hp. heavy duty portable pneumatic sweeping unit as used in large industrial plants, where a stationary unit would be too expensive. Smaller units of ½ hp. and ¾ hp. in portable form will be shown for use in office buildings and other large institutions.

THE ALLEN-SHERMAN-HOFF CO., 261 South 15th St., Philadelphia, Pa. Booth 75; First floor.

This company will exhibit a Hydrojet system for the handling of ashes, its type C water collecting ash gate, its quenchers, and its cast-iron coal bunker and accessories. The details and construction of the Hydrojet system will be fully shown, and the construction of the other devices will be demonstrated.

ALLIS-CHALMERS CO., Milwaukee, Wis. Booths 516-17; Third floor.

Its entire line of power plant equipment, including turbines, steam and gas engines, electrical machinery, pumps, air compressors, power transmission equipment and special machinery for mining and metallurgical work will be exhibited, also the details of the flour mills, and processes for timber preservation.

LOUIS ALLIS CO., 133 Stewart St., Milwaukee, Wis. Booth 512-15; Third floor.

This company will show special construction of its motors and the details of the indestructible rotor used in the H-D type.

ALSOP ENGINEERING CO., 47 W. 63rd St., New York, N. Y. Booth 212; Second floor.

Mixing machines and portable pumps will be the chief feature in this display.

AMERICAN AIR COOLED BLOCK ARCH COMBUSTION CO., 52 Vanderbilt Ave., New York, N. Y. Booth 665; Fourth floor.

Air cooled flat suspended block arches and the application of the A B C system of blocks for arch construction, side walls, roof arches and industrial furnaces. Blueprints and photographs of furnaces as constructed for various types of water tube boilers and demonstration of the method of rapid replacement of blocks.

AMERICAN ARCH CO., INC., 15 E. 42nd St., New York, N. Y. Booth 58; First floor.

Suspended arches, built of angle iron carried on cross pieces, and with steel clips for supporting suspended and interlocking pillar tiles will be the feature of this exhibit. Renewal of any section can be readily accomplished as will be demonstrated at the booth.

AMERICAN BLOWER CO., 6004 Russell St., Detroit, Mich. Booths 321-2; Second floor.

This exhibit will consist of the American Blower dry air filter, for the purification of air in ventilating or generator cooling systems. The details of construction of the unit cell type filter will be shown and the different methods of arranging these unit cells for various structures.

AMERICAN CAR & FOUNDRY CO., 30 Church St., New York, N. Y. Booth 203; Second floor.

Berwick electric metal heaters will be the feature of this exhibit. Included in the display will be an electric rivet heater, giving a constant steady flow of heated rivets; a gorging heater for upsetting or forging work; a bar heater which will be a model in miniature of the large size heater for heating 20 to 30 ft. bars.

AMERICAN FOUNDRY & EQUIPMENT CO., 366 Madison Ave., New York, N. Y. Booth 679; Fourth floor.

Special castings for high pressure and temperature work will constitute the features of the display in this space.

AMERICAN HOIST & DERRICK CO., St. Paul, Minn. Booth 515; Third floor.

Steam, electric and gasoline hoists, storage cranes, locomotive cranes, power shovels, and the details of the machinery will be illustrated in this exhibit, also the use of these devices for the storage and reclaiming of coal.

AMERICAN MACHINE & FOUNDRY CO., 5520 Second Ave., Brooklyn, N. Y. Booths 424-7; Third floor.

In this large space the Automatic Weighing Machine Co., a division of the American Machine and Fdry. Co., will exhibit its apron feed and automatic sacking scales. The apron feed scale is adapted for weighing materials, such as coal, cotton seed, clinkers and shale, a power feed being used to assure even flow. The automatic sacking scale is for filling bags or sacks with materials such as bone meal, fertilizer, stucco and the like. Another feature will be a complete line of rotary, high speed direct drive pumps, one of these being a fuel oil pump of new design, so arranged as to give an impulse effect. Methods of wrapping packages, automatically, will also be shown in the wrapping machine department, and the Wahlstrom Tool Co. will give a practical demonstration of its automatic tapping attachment and safety tapping chuck.

AMERICAN PIPE BENDING MACHINE CO., 37 Pearl St., Boston, Mass. Booth 770; Fourth floor.

Two pipe bending machines will be exhibited, one of them being demonstrated in operation, making cold pipe bends every 15 min. during the period of the show. The exhibit will illustrate the "Wonder" hand and motor-operated machine for bending pipe on the job.

AMERICAN PULLEY CO., 4200 Wissahikon Ave., Philadelphia, Pa. Booths 547-8; Third floor.

Standard lines of steel split belt pulleys, pressed steel shaft hangers, with ring oiled babbitt bearings, and other articles of pressed metal will be shown in this exhibit.

AMERICAN SCHAEFFER & BUDENBERG CORP., 338 Berry St., Brooklyn, N. Y. Booth 74; First floor.

Complete line of American industrial instruments will be shown for indicating, recording and controlling pressure, temperature and speed. Included in this line will be indicating and recording gages and thermometers, also stationary tachometers, engine indicators, steam traps, vacuum and U gages, dial thermometers, gage testers, pop safety and water relief valves, revolution counters and control apparatus for pressure, temperature and humidity.

THE AMERICAN WELL WORKS, Aurora, Ill. Booth 662; Fourth floor.

Here will be exhibited the multiple stage split shell centrifugal pump of the company's manufacture, also a standard Underwriter's fire pump, deep well cylinders, belt-driven

solid shell centrifugal pump and a working model of a two-stroke deep well plunger pump.

B. C. AMES Co., Waltham, Mass. Booth 646; Fourth floor.

Through its distributors, the Triplex Machine Tool Co., the B. C. Ames Co. will exhibit its bench lathe, bench milling machine, combination lathe, milling machine and drill press, and a complete line of micrometer dial gages.

ANACONDA COPPER MINING Co., 25 Broadway, New York, N. Y. Booth 65; First floor.

This booth will be shared by the American Brass Co. of Waterbury, Conn., the exhibit consisting of a general line of brass, copper and nickel silver materials particularly those products used in power plants, such as condenser tubes, steam and hot water tubing, rods and bars for engineering purposes, Tobin-bronze piston rods and shafting, bare and insulated copper wire and cable, rectangular and tubular bus bars, and various grades of Anaconda welding rods, now extensively used to salvage gears, broken castings and so forth. Turbine blading of various alloys will also be on display.

ANDALE ENGINEERING Co., 1015 Chestnut St., Philadelphia, Pa. Booth 564; Third floor.

Duplex water and oil strainers will be shown here in various types and sizes and also sectional models to show details of construction.

ANDREWS-BRADSHAW Co., 530 Fourth Ave., Pittsburgh, Pa. Booths 17, 189-90; First floor.

The Tracyfier, a steam purifier for removing foam, water fog and mist from steam before the steam leaves the boiler drum, will be shown in this exhibit space. Arrangements of the Tracyfier in the boiler will be illustrated and its effectiveness demonstrated in supplying steam free of impurities and suspended matter.

ARMSTRONG CORK & INSULATION Co., Pittsburgh, Pa. Booths 334-5; Second floor.

Exhibit will include high temperature insulating materials of all kinds and insulation for refrigeration lines.

ARMSTRONG MACHINE WORKS, Three Rivers, Mich. Booth 275; Second floor.

All sizes of Armstrong traps and sectional models will be shown, also a glass trap in operation on steam pressure so that the entire cycle of operation may be followed. Features which will be specially demonstrated are non-air binding, self-scrubbing and quick valve action. A sectional model of the Armstrong compound trap, the latest addition to the line, will be displayed.

THE ASHTON VALVE Co., 126 Liberty St., New York, N. Y. Booth 38; First floor.

Ashton products, including the full line of steam specialties will be shown in this exhibit, consisting of pop safety valves, relief valves, pressure and vacuum gages, whistles, and gage testing outfits.

ATLAS VALVE Co., 282 South St., Newark, N. J. Booth 635; Fourth floor.

This company will feature the Campbell feed water regulator in actual operation applied to a 3-hp. gas-fired boiler operating at 100 lb. pressure. The unit will be complete and will be equipped with a miniature feed water pump and feed water heater supplying the boiler with feed water at a temperature of about 170 deg. The features of the regulator such as simplicity, few working parts, low cost and simple feed water control will be fully demonstrated.

ATWOOD & MORRILL, Salem, Mass. Booths 562-3; Third floor.

Turbine and condenser valves, for high temperatures and pressures, special valves for low pressure superheating work and the company's new damper regulator.

AUTOMATIC ELECTRIC Co., INC., 1033 W. Van Buren St., Chicago, Ill. Booth 473; Third floor.

Special electrical devices for the control of operation of power plant machinery.

AUTOMATIC PRIMER Co., 111 W. Washington St., Chicago, Ill. Booth 244; Second floor.

Apco primers for centrifugal pumps, for producing vacuum without mechanical contrivances or foot valves.

BABCOCK & WILCOX Co., 85 Liberty St., New York, N. Y. Booth 51; First floor.

Construction of water tube boilers and superheaters and illustration of the installations made in numerous large plants.

E. B. BADGER & SONS Co., Boston 14, Mass. Booth 436; Third floor.

This exhibit will show a full line of the Badger expansion joints of self equalizing corrugated type, and of the company's non-clog, spray nozzles, illustrating their use and arrangement for various types of cooling ponds.

BAILEY METER Co., E. 46th at Euclid, Cleveland, Ohio. Booth 51; First floor.

Equipment displayed by this company will consist of different styles and sizes of meter panel boards, as well as a complete line of Bailey boiler meters, fluid meters, pressure and temperature recorders, tachometers and multi-pointed gages. Of especial interest will be a section of pyrex glass pipe through which water will be circulated at different rates of flow to demonstrate the effect of various pipe fittings upon the flow of fluids. Bailey meter control for regulating supply of fuel and air to boiler in accordance with the demand for steam will be in operation, demonstrating the efficiency of this equipment.

THE BALDWIN CHAIN & MFG. Co., Worcester, Mass. Booth 750; Fourth floor.

Steel roller chain and precision silent chain running over suitable sprockets on a frame prepared for the purpose and in operation so as to maintain a live exhibit, will be found in this booth.

THE BALLWOOD Co., 30 Church St., New York, N. Y. Booth 214; Second floor.

The company's line of pipe fabrication will be shown, consisting of forged hammer welded flanged piping and reinforced square corner Van Stone Joints. In addition will be shown a new complete line of Van Stone joints made of seamless steel piping for 600 lb. pressure, sizes from ¾ to 6-in. Heretofore, Van Stoning has not been used below 4 in. in size and, while the samples will run only to 6 in. in diameter, the company has fabricated up to 22 in.

BARCO MANUFACTURING Co., 1801 Winnemac Ave., Chicago, Ill. Booth 545; Third floor.

Barco flexible joints for oil, steam, air, gasoline, water and other fluids will be shown, with the construction of the spherical packed bearing. Also will be included the Barco balanced and lubricated plug valve, which is balanced and supplied with lubricant under pressure to prevent sticking.

BARNES & JONES, 5 Melrose St., Boston, Mass. Booths 312-13; Second floor.

Demonstration will be made of specialties for modulation, vapor and vacuum heating systems, of thermostatic radiator traps, vacuum returns, blast, boiler return and vent traps and of modulation valves for steam and water heating systems.

BARTLETT-HAYWARD Co., Baltimore, Md. Booths 344-5; Second floor.

Standard shaft couplings and special couplings applicable to steel mill service will be shown with photographs of representative installations and detailed drawings of the various types of couplings.

BASSICK MFG. Co., 2650 N. Crawford Ave., Chicago, Ill. Booths 480-1; Third floor.

Application of the Alemite forced grease lubricating system for machinery, shafting and power plant equipment.

THE BAYER Co., 4067 Park Ave., St. Louis, Mo. Booths 346-7; Second floor.

Soot blowers for all types of boilers, including a valve-in-head blower, model K-2, with a special attachment to the blower head for providing air circulation through the blower element when not in use will be found in this exhibit. The details of the blowing system and the action of the valve-in-head control will be fully illustrated.

BEARIUM BEARINGS, INC., 29 Broadway, New York, N. Y. Booths 524-8; Third floor.

This concern will occupy these spaces in association with Topping Brothers who are distributors for the New York district. Rough and machined bearings for all types of service will be shown, and demonstration made of the non-scoring, non-seizing emergency feature of the Bearium metals at high speeds without lubrication.

R. H. BEAUMONT Co., 319 Arch St., Philadelphia, Pa. Booth 50; First floor.

In this booth will be shown a complete working model of a centralized coal and ash handling system, illustrating the reception of coal at the plant in railroad cars, elevation by a skip hoist, discharge to a tram car and distribution by this car over the bunker. The demonstration will also show how coal is elevated and discharged through a chute to the storage field when the bunker has been filled, and how the coal is reclaimed by a cable drag scraper system from the storage field and again elevated to the bunker. Coal is distributed to the stokers as needed by a weigh larry.

BERNITZ FURNACE APPLIANCE Co., 80 Federal St., Boston, Mass. Booth 78; First floor.

A full sized layout of S-100 series Bernitz carbofrax super blocks will be shown, also a portion of a layout of the Bernitz "TU" pulverized fuel furnace lining. Each will be shown in a typical layout as used for furnace construction. Other standard ventilating blocks and shapes will also be in the exhibit.

BETHLEHEM SHIPBUILDING CORP., LTD., Bethlehem, Pa. Booths 70-1; First floor.

This company will exhibit the Bethlehem Diesel engine, Bethlehem oil burning equipment and Bethlehem pumps of direct acting type, of turbine driven type and also its feed water heaters.

BETHLEHEM STEEL CO., Bethlehem, Pa. Booths 70-1; First floor.

Here will be featured the new Bethlehem pulverizer, also the Bethlehem Diesel engine. The pulverizer is of the roll tire type with roller bearings protected from dust and is suitable for pulverizing not only fuels but minerals and other kinds of granular material.

BIAX FLEXIBLE SHAFT CO., 136 Liberty St., New York. Booth 757; Fourth floor.

Machines will be shown designed especially for the use of automobile, woodworking, stone cutting and finishing plants, railroad and street railways, machine and pattern shops, cleaning of boilers, foundries, motors and motor repair shops.

THE BIGELOW CO., New Haven, Conn. Booth 68; First floor.

Features of the various types of boilers made by this company will be illustrated by drawings, pictures and detailed parts. These will cover the Bigelow-Hornsby, Bigelow horizontal return tubular, Bigelow two pass, Bigelow Manning, Bigelow electric steam generator. There will also be a working model of the Bigelow-Hornsby boiler in actual operation.

L. C. BIGELOW & CO., INC., 250 W. 54th St., New York, N. Y. Booth 752; Fourth floor.

This exhibit will include the Ganschow type A planetary speed transformer and the Ganschow worm gear reducers, made by Wm. Ganschow Co., of Chicago, Ill., showing the uses of these speed reducers in power plant practice. There will also be included the Wear-Ever Production tools made by Scully Steel & Iron Co. of Chicago, with demonstration of their possibilities in rapid production.

THE BLACKBURN-SMITH CORP., 25 W. 45th St., New York, N. Y. Booth 244-5; Second floor.

Prominent among the exhibits in these booths will be the Blackburn-Smith feed water filter and grease extractor for removing oil and sediment from boiler feed water; the multiduct strainer for removing solid matter such as sticks and trash from general water supply; the Apco automatic primer, made by the Automatic Primer Co., of Chicago, for priming horizontal centrifugal pumps without the use of foot valves; Hart force sight feed oil pumps, and other products of the Sherwood Mfg. Co., of Buffalo, N. Y.; the Michaels automatic drain valve for freeing the drain connections of the cylinders of engines, pumps, and other machinery automatically from water of condensation. The primer will be shown in operation and the other devices in detail.

BOIG & HILL, INC., 180 Washington St., New York, N. Y. Booth 10-A; First floor.

A complete line of Curtis engineering specialties as made by the Julian d'Este Co. will be shown, comprising pressure regulators, damper regulators, steam traps, household water regulators, and temperature regulators for hot water.

BOILER ENGINEERING CO., 931 Federal Trust Bldg., Newark, N. J. Booth 450; Third floor.

A full-size section of a Beco baffle wall will be shown, illustrating the simple design by which the walls are made self supporting, and thus reduced greatly in weight.

BOSTON GEAR WORKS SALES CO., Norfolk Downs, Mass. Booths 340-1; Second floor.

Standardized speed reduction units and Boston silent chain drives with hardened ground-tooth spur gears.

BOTFIELD REFRACTORIES CO., Philadelphia, Pa. Booth 546; Third floor.

This exhibit will be devoted to Adamant fire brick cement, showing a number of unusual forms of construction possible with this material. Interesting power plant service data will also be shown and the single ring arch built with Adamant, showing a thin layer of the material supporting over 150 lb. of fire brick.

S. F. BOWSER & CO., INC., Fort Wayne, Ind. Booth 739; Fourth floor.

The Bowser and Richardson Phenix system for lubrication, oil filtration and storage of oil with demonstration of the operation of the complete systems.

BRADLEY WASHFOUNTAIN CO., Milwaukee, Wis. Booth 247; Second floor.

Sanitary washroom equipment for plants and factories.

THE BRISTOL CO., Waterbury, Conn. Booth 12; First floor.

This exhibit will cover the company's complete line of recording instruments for the power plant, including pressure and vacuum gages, thermometers, pyrometers, water level gages; also electrical instruments, including voltmeters, ammeters and wattmeters.

THE BROWN INSTRUMENT CO., Philadelphia, Pa. Booth 24; First floor.

Here will be found a display especially designed to illustrate the basic operating principle of the new Brown Electric flow meter—the inductance bridge principle. In the exhibit will be found a number of models of the meter, including the indicator and the duplex indicator which shows steam flow and steam pressure, the circular chart recording instrument and the strip chart recorder with single record, duplex record, or multiple record. Another important feature will be latest models of the company's electric CO_2 meter in the boiler-front type indicator, the switchboard type indicator with double scale to indicate CO_2 and flue gas temperature and strip chart recording types in single, duplex and multiple record models. Pyrometers, resistance thermometers, and other Brown instruments, such as pressure gages, draft gages, etc., will be included in the exhibit.

BUFFALO FORGE CO., 490 Broadway, Buffalo, N. Y. Booth 73; First floor.

Interesting display will be made of the Buffalo mechanical draft apparatus, including forced draft and exhaust draft fans for stoker-fired plants, blowers for pulverized coal plants, ventilating fans, with details of blast wheels, bearings and special fans for stoker plants. The Carrier generator coolers will also be demonstrated with details of the methods of cooling and washing the air.

BUFFALO STEAM PUMP CO., Buffalo, N. Y. Booth 73; First floor.

Here will be found a new development since last year, namely a class FF high-speed, high-head, single-stage centrifugal pump especially designed for motor or turbine speeds up to 3600 r.p.m. Another new development will be a class CH single-stage, single-suction pump of centrifugal type. Other features will be a multi-stage centrifugal pump and single-stage, double-suction centrifugal pump, both with horizontally split casings, opened up to show details of construction.

BUILDERS IRON FOUNDRY, 9 Codding St., Providence, R. I. Booth 277; Second floor.

This exhibit will be unusual, as the Venturi meter equipment shown will be in its latest perfected form after long power plant service. Use of the meter for measurement of boiler feed water, turbine condensate, cooling water, evaporator discharge and cold water make-up will be shown in registering, indicating and recording form. A cast steel Venturi meter tube will be exhibited for operating pressures up to 1000 lb., and a similar tube of cast iron for low pressures. A radial planimeter of special form will be demonstrated for obtaining totals from Venturi charts and the register-indicator-recorder apparatus will be piped so that the meter can be shown in actual operation.

BUNDY STEAM TRAP CO., 26 Cortlandt St., New York, N. Y. Booth 8; First floor.

This company will exhibit a complete line of its steam traps, functioning under typical power plant conditions. New improvements will be shown such as ground joints at trunnion and elbow connections to eliminate vibration at these points; combination of bowl feed and discharge pipes and elbows, to give simplicity and reduction of parts; knife-edged bearings for bowl, lever and connecting rods, to reduce friction; monel valve seats and discs; shock-absorbing attachment on the lever rod to give smooth and quiet operation.

EDWIN BURHORN CO., 25 W. Broadway, New York, N. Y. Booth A; First floor.

Conspicuous in this exhibit will be a working model of the Burhorn cooling tower of packers type. This will be an exact reproduction, half size, of the Company's standard type towers, showing all details of construction. Two sides will be fitted with glass doors, so that the interior of the tower can be seen and the methods by which the water is distributed and broken up can be studied. Full-sized details of improvements in cooling surface will be shown also of

louver construction with cast-iron connections. Photographs of interesting installations of cooling towers will complete the exhibit.

A. M. Byers Co., Pittsburgh, Pa. Booth 429; Third floor.

Methods of manufacture of the Byers genuine wrought iron pipe and the qualities of that pipe as shown by test and by experience in practice will be demonstrated.

Andrew C. Campbell, Bridgeport, Conn. Booth 660; Fourth floor.

A novel device for the shaping of metals will be demonstrated in operation in this booth. The exhibit will include the latest type of No. 1 Nibbling machine and there will be in operation the No. 1-B machine of motor-driven type, operating on 1/16, 1/8 and 3/16-in. steel; the No. 2 machine, cutting 1/4, 5/16 and 3/8-in. steel; the No. 0 Bench Nibbler, cutting light gage steel up to its capacity of 3/32-in. This last machine is new, and this will be its first demonstration in public.

Carrier Engineering Co., 7501 Frelinghuysen Ave., Newark, N. J. Booths 14A-14B; First floor.

Air-conditioning equipment for heating and ventilating systems and for generator cooling.

The Casey-Hedges Co., Chattanooga, Tenn. Booth 504; Third floor.

Products of the company will be shown by an exhibit of large photographs of various types of boilers and of plant installations where these boilers have been used. There will also be a working model of one of the types, showing details of construction.

A. W. Cash Co., Decatur, Ill. Booth 276; Second floor.

Craig system of combustion control, including the type S master controller actuated by steam pressure, forced-draft fans, stoker pistons and boiler uptake dampers. Models of the complete line of pressure regulating devices manufactured by this company.

FIG. 2. EXHIBITS WILL COVER THE ENTIRE RANGE OF POWER PLANT OPERATION FROM COAL HANDLING TO STEAM CONDENSATION

The Carborundum Co., Perth Amboy, N. J. Booth 22; First floor.

This company's exhibit will consist of Carborundum and Aloxite refractory shapes and cements suitable for use in high-temperature boilers; industrial furnaces, water gas generators, oil refining stills and the like. It is also probable that the Carboradiant chamber will be exhibited, making possible the application of heat by radiation, burning oil, gas or powdered fuel.

Carrick Engineering Co., 538 S. Clark St., Chicago, Ill. Booth 264; Second floor.

Chronometer valves, furnace regulators and mercury-actuated master control for furnace regulation will be demonstrated in this booth. A working model of the master control will be shown with glass enclosure, showing the action of the mercury column in place of springs or diaphragms.

Celite Products Co., 1320 S. Hope St., Los Angeles, Cal. Booth 14; First floor.

Here will be shown a demonstration furnace, showing the effectiveness of installation of this company's products, a sample wall showing standard methods of installing insulation, blueprints and charts showing methods of construction and a complete display of Sil-O-Cel insulating brick, block, powder cements and aggregates. There will also be shown Celcote air-sealing compound and Fraxite refractory cement.

The Centrifix Corp., 3029 Prospect Ave., Cleveland, O. Booth 302-3; Second floor.

A complete line of devices will be shown in this space for the centrifugal separation of steam, air, gases, vapors and liquids, and the operation of the devices will be demonstrated.

THE CHAPMAN VALVE MFG. CO., 203 Hampshire St., Indian Orchard, Mass. Booth 2; First floor.

The Chapman Company will exhibit at this show a complete line of chrome nickel steel gate valves and fittings for high pressure and temperature service; also the Chapman motor unit as applied to a valve and connected for operating demonstrations, showing improvements and refinements in the unit; in addition a line of iron body gate valves for water and steam service and a representative line of brass valves for general service. Information will be available at the booth in regard to the company's research work carried out in connection with material for power plant service, including a complete report on the causes of bolt failures under severe conditions and the suggested remedy.

CHICAGO PIPETHREAD MACHINE CO., Racine, Wis. Booth 443; Third floor.

A Chicago No. 2 power pipe-threading machine with automatic opening die head, three speeds for fast operation and high-speed precision thread steel dies will be the feature of this exhibit. While this is designed for high production, the balance and weight are so distributed as to make it portable so that it can be used in any part of a plant for maintenance or construction work.

CHICAGO WILCOX MFG. CO., Chicago, Ill. Booth 274; Second floor.

Wilcox gaskets with heavy U-shaped metal cover and filling of asbestos, rubber or leather.

CLARAGE FAN CO., Kalamazoo, Mich. Booths 468-9; Third floor.

The company will show the following equipment; a type V air washer with all accessories; a type HV multi-blade fan for heating and ventilating work of all kinds; a type FD high-speed, force-draft fan which is a new development this year and comes regularly equipped with SKF ball bearings and Alemite greasing attachment. This is designed with rising pressure curve to assure ample air with heavy fuel beds and with a limiting horsepower characteristic to prevent overloading of the driver. Other exhibits will be the type SP exhauster, and the type V steam engine for operating stokers, fans, pumps and compressors in capacities of 5 to 85 hp. and with range of pressures 40 to 250 lb. The special feature of this engine is an automatic lubricating system. Other items included in the exhibit will be blast gates, dampers, ventilators and exhaust fans for powdered coal systems.

CLEVELAND WORM & GEAR CO., Cleveland, O. Booth 92; First floor.

Motor-driven worm gear, speed-reducing units.

CLIPPER BELT LACER CO., Grand Rapids, Mich. Booth 551; Third floor.

The entire Clipper line will be shown with four models of belt lacers, various sizes of hooks, including the "rust-proof" for use where corrosion occurs from moisture or acid fumes. Open and closed-end models of Clipper belt cutters will be included demonstrating the safety feature. Also the various sizes of connecting pins.

A Clipper electrically-operated moving display will show belts running under all sorts of conditions.

COCHRANE CORP., 17th St. and Allegheny Ave., Philadelphia, Pa. Booth 67; First floor.

Cochrane apparatus to be exhibited will include a deaerating heater complete with vent condenser, suitable for operation under vacuum, back pressure, or atmospheric pressure. A strainerless conical filter with single control valve, which is free from clogging of small orifices and gives ample back-washing and filtering by the use of a single valve; a flow meter of indicating, recording and integrating type with pressure or temperature recording pen acting on the same chart as the flow meter pen; a multiport back pressure valve with several disks arranged for convenient regulation of back pressure by direct or remote control; a sectioned steam or oil separator of horizontal type, also one of vertical type similarly sectioned; a high-pressure bucket type trap and a multiport drainer or low-pressure trap with large ports and balanced valves.

THE COEN CO., 112 Market St., San Francisco, Cal. Booth 15B; First floor.

Oil burners, air registers, oil heaters and other devices for oil-burning systems.

COFFIN VALVE CO., Neponset, Boston, Mass. Booths 409-10; Third floor.

Two exhibits will be arranged, one a gate valve equipped with a Kelty motor-drive unit of latest design, and the other a hydraulically-operated pivot valve, equipped with automatic solenoid control, allowing this valve to be used in pump discharge lines in place of a check valve. In addition will be shown a solenoid controlling valve for remotely controlling the operation of a hydraulic cylinder.

CONNERY & CO., 2nd St. above Erie Ave., Philadelphia, Pa. Booth 43; First floor.

Power plant engineers will be interested in studying here the construction of the air-cooled damper and wagon top breachings which have been installed in many plants during the past year, by the manufacturer. The wagon top breeching has special expansion stiffeners which are also adapted for use on air and preheater ducts.

CONTINENTAL VALVE & EQUIPMENT CO., Framingham, Mass. Booth 316; Second floor.

This company is exhibiting Framanco forged steel pipe fittings, flange unions, box unions and pump governors for extremely high pressures, also specially adapted for superheated steam work hydraulic service and for oil and gas refineries. They are equipped with octagon ends, to increase the strength against strain and to permit of greater convenience in handling the fittings.

COOLING TOWER CO., 15 John St., New York, N. Y. Booth 523; Third floor.

In this exhibit the special features will be the Tangldust air filters, impact and spirodrome spray nozzles, impact air washers and models of cooling towers. All these devices will be shown in detail, and their operation fully demonstrated.

COOPER-HEWITT ELECTRIC CO., 95 River St., Hoboken, N. J. Booths 698-9; Fourth floor.

Systems of lighting for industrial plants to avoid glare and eye strain.

CONSOLIDATED COAL CO., 67 Wall St., New York, N. Y. Booth 463; Third floor.

Samples of coal and illustration of the methods of mining and preparation.

CORK FOUNDATION CO., 315 Fifth Ave., New York, N. Y. Booth 761; Fourth floor.

Absorbo cork foundation mats will be shown here, for use in absorbing vibration and noise of all types of machinery including turbines, large engines, small motors, oil pumps, and other equipment.

CHAS. CORY & SON, INC., 183 Varick St., New York, N. Y. Booths 241-2; Second floor.

Products that the Cory Corporation will exhibit are classified as signaling, communicating, lighting, control and protective devices, flexible metal hose and other central station equipment. The signaling section will include turbine signals, load indicators, time clocks, annunciators, whistle operators and pressure gages. The communicating system will include the anti-noise telephone. The lighting system will include steam-tight fixtures, wiring appliances and switchboards. The control system will include valve operators and door operator systems. Protective devices will include interlocks, mechanical and electrical, ohmmeters, fire-detecting equipment and clear view screens.

CRANE CO., 836 S. Michigan Ave., Chicago, Ill. Booth 52; First floor.

Crane Co. will show a complete line of cast steel gate valves for pressures up to 900 lb. built in accordance with the American steel flange standard. Also several valves made of material other than steel. Some new designs will be shown of gate and globe valves, having forged parts throughout and trimmed with stainless steel for superheated steam service. The valve bodies are shaped by special process to get uniform section of metal after drilling and have a bolted bonnet joint connection with ground facing between the body and bonnet. A new receiver type steam separator will be shown with head of cast steel, and shell made of steel pipe, all joints being welded by the hammer weld process.

CROSBY STEAM GAGE & VALVE CO., 612 Marshall Bldg., Boston 8, Mass. Booth 98; First floor.

Nickeloy globe valves, bronze, monel and steel valves, relief valves, and a gage-testing machine for pressures up to 25,000 lb. Monel metal valves are designed for pressures up to 900 lb. and the cast steel valves are made for like service.

CURTIS & CURTIS CO., Bridgeport, Conn. Booth 472; Third floor.

Pipe cutting and threading machinery, including hand-operated machines, combined hand and belt-driven machines, direct-connected electric-driven machines, and pipe threading accessories, including the Curtis nipple holder.

THE CUTLER HAMMER MFG. CO. (See Payne-Dean Control.)

THE CUTTER ELECTRICAL & MFG. CO., 19th and Hamilton Sts., Philadelphia, Pa. Booth 701; Fourth floor.

Circuit breakers of great variety of construction and

for all conditions will be found in this exhibit. It will include a 4000-amp. I-T-E carbon circuit breaker of three-pole design for 440 v. a.c. equipped with a solenoid closing mechanism for remote control of the breaker; this breaker will be of the Autoite design, non-closable on overload. In addition there will be a number of U-Re-Lites, which are in reality I-T-E circuit breakers enclosed in a steel box. A 60-amp. Junior type for 230 v. d.c., a 150-amp. Senior type for 230 v. d.c., a 1250-amp. "NX" for 230 v. d.c., a 15-amp. Auto Junior for 550 v. a.c., and a 150-amp. Auto "W" for 550 v. a.c. will be shown. These are air-break devices and the story in regard to what they have done under test is well worth hearing.

THE DAMPNEY CO. OF AMERICA, Boston, Mass. Booth 248; Second floor.

Apexior protective coatings for preventing corrosion on the water and steam surfaces of power plant equipment such as boilers, economizers, feed water heaters, piping and steam turbines, will be the feature of this exhibit. Of especial interest will be a complete display of the power-operated brush equipment designed for application of these protective coatings to the internal surfaces of water-tube boiler tubes. This equipment is designed to place a uniform coating on the internal surfaces of straight or curved tubes for lengths up to 30 ft, and for internal diameters as small as one inch.

M. T. DAVIDSON CO., 154 Nassau St., New York, N. Y. Booths 36-7; First floor.

This company will exhibit steam and centrifugal pumps, with working models and with full details of construction and operation of the parts plainly shown.

DAVIS ENGINEERING CORP., 90 West St., New York, N. Y. Booths 415-16; Third floor.

Paracoil steam specialties will be shown here, including standard feed water heaters, storage water heaters, instantaneous water heaters, filter and grease extractors, waste heat boilers, and nonreturn steam traps. Special emphasis will be placed on the steam trap and the improved type Paracoil oil heater and feed water heater.

G. M. DAVIS REGULATOR CO., 422 Milwaukee Ave., Chicago, Ill. Booth 267; Second floor.

Pressure control and release valves of various types will be included in this exhibit. Among these will be pressure regulators for steam, air and gas reduction, back pressure valves for noncondensing service systems, atmospheric relief valves for condensing prime mover units, turbine bleeder line nonreturn valves, and turbine pressure relief valves, heater traps for condensate return to accumulator tanks, float valves and water level float boxes for internal and external control of make-up water, steam traps for condensate, oil or distillate and balanced valves for heater make-up control. Also will be shown a model of the new wing disk nonreturn valve recently perfected by this company, designed for service as a check valve where no drop in pressure across the valve is desirable.

DEARBORN CHEMICAL CO., 310 S. Michigan Ave., Chicago, Ill. Booth 13; First floor.

This booth will be operated as a reception space for friends and visitors of the company, and will have moving pictures taken at the company's laboratory and manufacturing plant, with some samples of the No-Ox-Id for display purposes. This material is for rust prevention and its effectiveness in doing this will be demonstrated.

THE DE LAVAL SEPARATOR CO., 165 Broadway, New York, N. Y. Booths 536-43; Third floor.

This company will show its crankcase oil reclaiming outfit, a No. 600 portable transformer oil outfit, a No. 202 similar outfit, a No. 900 and a No. 360 oil purifier. The crankcase oil outfit has been developed especially for the use of operators on motor vehicle fleets and makes it possible to keep the same oil in service for an indefinite period. The transformer oil purifier is a portable unit for purifying insulating oil of transformers and circuit breakers.

DE LAVAL STEAM TURBINE CO., Trenton, N. J. Booths 536-43; Third floor.

Reduction drives of worm and gear type will be shown, consisting of a small motor driving a speed reducer, which in turn will drive a speed increaser, hooked up to a small generating set. The worm has ball bearings and may be located either above or below the gear. With single reduction, this provides ratios up to 100 to 1, while with double reduction gears ratios up to 8000 to 1 can be secured. A medium size helical gear for either speeding up or speeding down will be shown, also several sizes of pinion shafts for double helical gears. Complete motor-driven pump test will be shown in operation with all testing auxiliaries, including venturi tubes, tanks, piping, gages, valves, and so forth. De Laval pin and rubber bushing type flexible couplings will be shown up to 24-in. size, and a De Laval velocity stage turbine will be shown in section to illustrate the special design for modern high steam pressure.

JULIAN D'ESTE CO., 26 Canal St., Boston, Mass. Booth 10; First floor.

Here will be found a representative line of the Curtis engineering specialties, including pressure regulators for steam, air, water and gas, Curtis and d'Este types of combustion controls and a complete line of traps in float bucket and expansion and return forms.

M. H. DETRICK CO., 50 Church St., New York, N. Y. Booth 94; First floor.

Here will be shown the Detrick sectionally-supported side wall, especially adapted for pulverized fuel boiler settings, and the Detrick flat suspended arch. Also details of the construction and photographs and drawings of the walls and arches as adapted to various makes and types of boilers.

DETROIT STOKER CO., General Motors Bldg., Detroit, Mich. Booths 204-6; Second floor.

Stoker in operation to demonstrate the principles of its underfeed forced draft multiple retort design; also worm gear drive for stokers with adjustment for controlling the stroke of the pusher rod.

DIAMOND POWER SPECIALTY CO., Detroit, Mich. Booth 16; First floor.

Valv-in-head soot blowers and other models, including rear end soot blower for return tubular boilers; patented barriers for protecting soot blower units.

WALTER S. DICKSON CO., 90 West St., New York, N. Y. Booths 232-3; Second floor.

Heating and ventilating specialties.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J. Booth 254; Second floor.

Dixon's flake graphite, graphite greases, silica-graphite paint, aluminum graphite paint, graphite pipe joint compound and other miscellaneous graphite products which are of value for lubricating and for protecting structures about the plant will be included here.

DODGE MFG. CO., Mishawaka, Ind. Booths 478-9; Third floor.

Power transmission equipment, including split pulleys with wood bushings, hangers, shafting and rope drive equipment.

DRAKE NON-CLINKERING FURNACE BLOCK CO., INC., 5 Beekman St., New York, N. Y. Booth 227; Second floor.

Standard, Utility, S-X and Carbo-glazed block for furnace linings, bridge walls and kilns.

DURABLA MANUFACTURING CO., 114 Liberty St., New York, N. Y. Booths 493-4; Third floor.

This exhibit will feature the Durabla brand of products, including compressed asbestos fibre sheet packing, semi-metallic rod packing, high-pressure gage glasses, valve discs, metal pump valves. In connection with the pump valves will be shown in operation an exhibition pump with glass sides for the chambers so that the actual operation of pump valves can be observed, also flow of fluid through the valves.

EASTERN STEAM SPECIALTY CO., INC., 242 Lafayette St., New York, N. Y. Booth 440; Third floor.

This company will conduct a double exhibit for the Instant Water Heater Co. of Chicago and the M. J. L. Flow Indicator of Los Angeles. Details of construction will be shown for the Instant water heater, including the heating element of copper tubes enclosed in a steel shell, so arranged that cold water entering the heater passes through the central chamber the full length of the heater, surrounded by steam, a design intended to get the maximum of efficiency with a minimum of space occupied. The M. J. L. flow indicator is for measuring the flow of various liquids, air, steam or gas, suitable for vertical or horizontal lines of any size, and for close by or remote installations.

THE EDWARD VALVE & MANUFACTURING CO., East Chicago, Ind. Booth 30; First floor.

Edward valves in all the company's forged steel lines, including the new "offset" design for 600 and 900 lb. pressure will be shown. Panels of enlarged sectional drawings will bring out in detail the designs of the Edward products and their advantages.

The offset design is a departure from usual valve practice to provide for even distribution of metal and the conducting of expansion stresses of the pipe line to points above and below the valve seat.

EDGE MOOR IRON CO., Edge Moor, Del. Booths 288-9-90; Second floor.

This company will have an exhibit illustrating its entire line of products, including Edge Moor longitudinal drum boilers, waste heat boilers, cross drum boilers, heating boilers, and single pass boilers. All these will be shown with details of construction, plants where they have been installed and test data, available for the study of visitors.

ELLIOTT CO., Jeannette, Pa. Booths 271-3; Second floor.

Complete illustration will be given of this company's products, including strainers, filters, separators, feed heaters, deaerators, turbines, generators, boiler tube cleaners and other specialties. Specially interesting features of the exhibit will be a 100-kw. geared turbine generator set, a Kerr steam turbine and a Ridgway generator. Construction of the various products will be shown by detail parts and cut-out models or by opening up machines for inspection.

LEWIS M. ELLISON, 214 W. Kinzie St., Chicago, Ill. Booth 44B; First floor.

New exhibits shown in this space will be the Ellison pointer draft gage of the gasometer ball and beam type with vertical straight line reading scale, the Ellison U path calorimeter, which throttles, separates and re-evaporates in a single chamber and is protected against radiation by a steam jacket and insulating jacket of lamp black and a bright surface casing. The regular line of Ellison inclined and vertical draft gages will also be shown in this exhibit.

CHARLES ENGELHARD, INC., 30 3rd St., New York, N. Y. Booth 611; Fourth floor.

Electrical instruments for measuring and recording temperatures, CO_2, in single and multiple form. These will be shown in both switchboard and portable types.

THE ENGINEER CO., 17 Battery Pl., New York, N. Y. Booth 18; First floor.

In the exhibit of this company will be found the Enco electric balanced draft equipment, hydraulic balanced draft equipment, oil-burning equipment and pulverized fuel burner. Turner baffle walls will also be shown and the designs of Enco cross baffling for vertical water-tube boilers. The pulverized coal burner and the new application of plastic baffles for vertical water tube boilers are novelties and worthy of careful attention.

ERIE CITY IRON WORKS, Erie, Pa. Booths 219-20; Second floor.

The main feature of this exhibit will be one of the company's new Unitype coal pulverizers, arranged to show the complete details of construction and method of operation. In addition there will be cuts, drawings and descriptive literature of their new inclined three-drum water-tube boiler, also literature will be available on the rest of the Company's products, including horizontal and vertical water-tube boilers, horizontal and vertical tubular boilers, and the Economic self-contained tubular boiler.

ERNST & CO., Newark, N. J. Booth 76; First floor.

Water columns with inclined gage glass, where the water shows red. Gage glass valves and safety gage glasses.

EVERLASTING VALVE CO., Jersey City, N. J. Booths 100-1; First floor.

For the first time, this company will present the boiler drawoff Wylie Wilson process for handling boiler blow-off at all pressures, especially those prevalent in the high-pressure plants of today. In addition to this there will be the regular line of Everlasting valves and Everlasting Tandem valves, Model X, also the angle valve. This companion angle valve with the regular Everlasting valve gives the Everlasting Duplex blow-off combination. The regular valves will operate for working pressures up to 500 lb. while the drawoff process will operate at any pressure whatever.

EX-CELL-O TOOL & MFG. CO., 4069 E. Grand Blvd., Detroit, Mich. Booth 661; Fourth floor.

XLO bushings, grinding spindles and similar products.

THE FAFNIR BEARING CO., New Britain, Conn. Booth 246; Second floor.

Industrial ball bearing applications, including hanger boxes, pillow blocks, machine bearings and a special line of radial and thrust bearings will be shown in this exhibit.

FAIRBANKS-MORSE & CO., 900 S. Wabash Ave., Chicago, Ill. Booths 326-31; Second floor.

Centrifugal pumps, electric motors, reciprocating pumps and the type Y Diesel engine. Special features of design will be ball bearing pumps and motors.

FALK CORP., Milwaukee, Wis. Booths 338-9; Second floor.

Gears and couplings, including a double reduction speed reducer and herringbone gears, especially designed for conveyor drive, and with variable reduction. Falk-Bibby flexible couplings connecting a single-stage centrifugal pump to its starting motor, arranged so that the front and rear ends can be thrown off center 6 deg.

FEDERAL GAGE CO., 25 Church St., New York, N. Y. Booth 535-44; Third floor.

Indicating and recording gages for pressure and vacuum, also mercoid switches with automatic motor control actuated by changes of temperature and pressure, vacuum or position of a float.

THE FISHER GOVERNOR CO., INC., Marshalltown, Ia. Booth 35; First floor.

This company's list of exhibits will include pump governors, reducing valves, steam traps, float valves, liquid level controllers, both direct-connected and remote control. Specially featured will be the type 240 liquid level controller, actuated by sensitive bellows and liquid transmission, with valve located at a distance from the bank.

FLETTNER CORP. OF AMERICA, 68 Beaver St., New York, N. Y. Booth 630; Fourth floor.

The exhibit will consist of models, photographs, blueprints and descriptions of the inventions of Anton Flettner, including the Rotorship, rotor ventilator, rudder and windmill.

FLEXIBLE STEEL LACING CO., 4607 Lexington St., Chicago, Ill. Booth 460; Third floor.

Methods for making belt joints will here be shown, including the Alligator steel belt lacing, and the methods of using it to secure a pin joint. Also the Flexco H. D. belt fasteners will be shown for conveyor and other heavy belting. Another feature in the exhibit will be the Flexco-Lok lamp guards for protecting incandescent lamps against breakage and pilfering.

FLYNN & EMRICH CO., Holliday and Saratoga Sts., Baltimore, Md. Booth 46; First floor.

Huber stokers in large size and actually handling fuel, showing the coking of the fuels before feeding to the grates and the supply of secondary air.

FOOTE BROS. GEAR & MACHINE CO., 215 N. Curtis St., Chicago, Ill. Booth 550; Third floor.

In this display will be found an interesting demonstration of reducing gears of various types. This will include a worm gear reduction of Type 1-W, the smallest size manufactured, a type S single reduction spur gear unit, type 2D quadruple reduction unit, single and triple herringbone reduction units, combination spur and worm gear unit giving total reduction of 3600 to 1, panels illustrating various types of gears manufactured and also the IXL timing gears. It is hoped to have on exhibit a high-efficiency worm gear reduction unit at the show.

FOSTER ENGINEERING CO., 109 Monroe St., Newark, N. J. Booth 84; First floor.

This company expects to display numerous types of pressure regulators for various purposes, also a considerable number of pump governors. Some of these are for high-pressure service up to 400 lb. and superheated steam. There will be included back-pressure valves, relief valves of several types, float valves for steam and water, automatic stop and check valves for 440 lb. of standard construction, non-return stop valves of the through-bolt bonnet type, fan engine regulators and lever-balanced valves. The Foster flexible ball joint will be shown, also the Foster sight flow box will be given practical demonstration.

THE FOXBORO CO., INC., Foxboro, Mass. Booth 62; First floor.

Here will be found the company's line of indicating, recording and controlling temperature, pressure and humidity instruments, together with CO_2 recorders, indicating and recording differential boiler level instruments, storage tank indicating and recording liquid level instruments and a general line of power plant instrument equipment.

THE FREDERICK IRON & STEEL CO., Frederick, Md. Booth 501; Third floor.

This company will exhibit centrifugal pumps, both multi-stage and single-stage, also an operating model of the Frederick revolving roll separator for grading anthracite and bituminous coal and also used in grading coke. The machine is also adapted for handling limestone, rock and other products.

FULLER-LEHIGH CO., Fullerton, Pa. Booth 54; First floor.

Pulverizing and feeding apparatus will constitute the features of this exhibit, and the Bailey furnace wall will also be shown. Among the equipment will be a Fuller-Kinyon pump for transporting pulverized fuel, a Fuller single screw pulverized coal feeder, models of the Fuller pulverizer mill, and of the Fuller horizontal pulverized coal burner, model of the Randolph vertical waste heat dryer,

a Narragansett Feeder and meter, Turbulent pulverized coal burners. Details of the Bailey water-cooled furnace wall will also be shown, and its construction fully demonstrated.

THE FULTON CO., Knoxville, Tenn. Booths 252-3; Second floor.

Sylphon apparatus for regulating temperature and pressure and its adaptation for special uses. A special feature will be a thermostatic water mixer for mixing hot and cold water and giving any resulting temperature desired.

FURNACE ENGINEERING CO., INC., 5 Beekman St., New York, N. Y. Booth 41; First floor.

The Simplex unit pulverizer with revolving hammers, air separator and fan, in capacities from 1500 to 15,000 lb. per hr.

G. & G. ATLAS SYSTEMS, 537 West Broadway, New York, N. Y. Booth 87; First floor.

Pneumatic tubes for mechanical messenger service in shops, offices and stores will be the exhibit found in this space, showing details of tubes, carriers and actuating equipment.

WILLIAM GANSCHOW CO., 34 N. Morgan St., Chicago, Ill. Booth 762; Fourth floor.

Spur gear and worm gear speed transformers for direct or right angle drives in horizontal and vertical form. Cut gears, in worm, spur, bevel and mitre type.

THE GARLOCK PACKING CO., Palmyra, N. Y. Booth 505; Third floor.

Here will be found a complete line of asbestos, rubber, metal and fibrous packings in all shapes and for all conditions of temperature and pressure. Specially featured will be the Garlock packing service for assisting in solving packing problems.

GENERAL ELECTRIC CO., Schenectady, N. Y. Booths 4-5; First floor.

Flow meters, brush shifting motor for alternating current, air-cooling systems for turbine generator ventilation and motor and control equipment. Flow meters will be shown in operation with steam generated in an electric boiler.

GENERAL REFRACTORIES CO., 40 Rector St., New York, N. Y. Booth 530; Fourth floor.

In this exhibit will be shown fire brick with special content of silica, of magnesite, of chrome, of high alumina, and the Grefco high-temperature cement. Uses of these various products will also be shown and the various shapes in which they are available.

GILLIS & GEOGHEGAN, 539 W. Broadway, New York, N. Y. Booth 88; First floor.

Two complete ash-removal equipments will be shown, both electrically-operated and so set up that the effect will be the same as if the visitor were standing in the boiler room.

GIRTANNER ENGINEERING CORP., 122 Greenwich St., New York, N. Y. Booth 258; Second floor.

In this space will be found a display of the Girtanner standard line of steam jet, vacuum and hydraulic pipe line conveyors. As a main feature, a miniature model of a steam jet ash conveyor system will be in actual operation. Also a model of a Girtanner Hydraulic ash and soot conveyor system will be shown at work. Both models will be arranged and operated to duplicate actual plant conditions so far as possible.

GITS BROS. MFG. CO., 1940 S. Kilbourn Ave., Chicago, Ill. Booth 610; Fourth floor.

This exhibit will contain a complete line of oil cups, oil hole covers, auto chassis oilers and gravity and capillary attraction wick feed oilers. The latter being especially adaptable for power plant service.

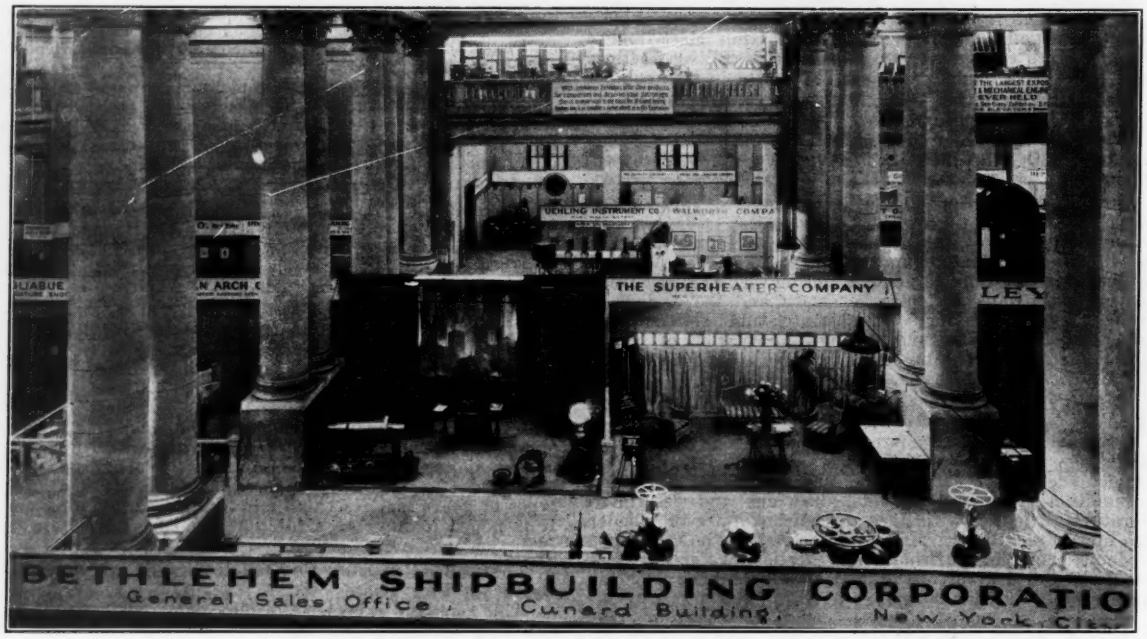


FIG. 3. HANDLING OF HIGH PRESSURE AND HIGH SUPERHEAT STEAM WITH SPECIAL FITTINGS AND MEASURING INSTRUMENTS REQUIRED WILL BE COVERED IN THE EXHIBIT

S. FABIAN GOODMAN, 1834 Broadway, New York, N. Y. Booth 482; Third floor.

RHL ball and roller bearings will be shown, also steel balls and ball bearing pillow blocks.

JAMES T. GORDON CO., 63rd St., New York, N. Y. Booth 92; First floor.

Water and oil strainers, worm gear and reduction units, and Nicholson steam specialties.

A. P. GREEN FIRE BRICK CO., Mexico, Mo. Booths 201-2; Second floor.

High alumina refractory products will be the feature of this display of fire brick, the Kruzite and Mizzon brands; of super-plastic material, the Mizzon Quik-pach; of air-setting cement, the Sairset. Fire clay refractories will also be shown, including fire brick, special shapes, Quik-pach plastic, Mexi-Romo mortar and Diamond Jo high-temperature cement.

GRISCOM-RUSSELL CO., 90 West St., New York, N. Y. Booth 49; First floor.

Reilly evaporators, water heaters and multiwell oil coolers, U-fin generator air coolers, evaporators and Stratton steam and air separators. Special feature will be the Griscom-Russell bent tube evaporator with headers arranged vertically and held rigidly top and bottom so that the bend-

ing of tubes due to change in temperature cracks off scale which may form.

GURNEY BALL BEARING CO., Jamestown, N. Y. Booth 343; Second floor.

Gurney ball bearings for industrial and special use.

HAGAN CORP., Bowman Bldg., Pittsburgh, Pa. Booth 21; First floor.

In this exhibit will be found a system of combustion control, similar to the one now being completed for the Port Morris station of the New York Central Railroad. It will have a central control panel from which all boilers in the plant can be adjusted simultaneously, each boiler being handled individually. Another feature of the Hagan exhibit will be the boiler water conditioning outfit as to be installed in the New York Edison plant at 14th St. There will also be found a standard line of apparatus, including steam purifier, master regulator, combustion controller, roto valves, and other water-conditioning apparatus.

HARDINGE CO., York, Pa. Booth 337; Second floor.

Working models will be shown of the Hardinge conical mill and reverse current air classifier, also of the Ruggles-Coles dryer and the Hardinge super thickener and clarifier. All these devices are for use in connection with the preparation and treatment of coal.

THE HAYS CORP., 1042 E. 8th St., Michigan City, Ind. Booth 81; First floor.

Hays gas analysis apparatus, including the Hays tester, Hays portable draft gages, CO_2 and draft recorder, dial type gages for draft and pressure, and inclined tube draft gages.

HEINE BOILER CO., St. Louis, Mo. Booths 694-5; Fourth floor.

Blueprints will be shown of typical Heine boiler installations and of the design of the new high-pressure bent tube type of boiler, also large photographs of recent installations. In the exhibit will be found samples of boiler construction and special furnace apparatus of the company's design.

HENDRICK MFG. CO., Carbondale, Pa. Booth 431; Third floor.

Perforated metal screens, elevator buckets and Mitco shaft heads and steel gratings.

PAUL F. HERMANN, Keenan Bldg., Pittsburgh, Pa. Booth 737; Fourth floor.

Displays will be made of high-grade stationary and operating industrial models for advertising purposes, including a coke oven, a model of a steam yacht, a large operating model of a dock pump, a model of a crane, bridge structures and other features.

HOFFMAN SPECIALTY CO., INC., 25 W. 45th St., New York, N. Y. Booths 633-4; Fourth floor.

In this space will be shown a complete line of Hoffman air valves and heat control specialties, also several of the company's make of traps under actual operating conditions.

THE M. A. HOFFT CO., 814 W. Washington Ave., Indianapolis, Ind. Booth 502; Third floor.

This company is planning to have a moving picture machine showing the making of repairs on an arch and also moving pictures to show methods of refuse burning. Details of its National stoker and National arch will also be found in the exhibit.

HOMESTEAD VALVE MFG. CO., Homestead, Pa. Booth 428; Third floor.

Homestead quarter-turn valves for water, air and steam pressures will be shown as made in straightway, threeway and four-way types for pressures up to 3000 lb. per sq. in. In addition the Homestead lubricated valve, a plug type with lubrication by means of the Alemite system will be exhibited and the Hovalco boiler blow-off valve as well as the Homestead-Hovalco combination blow-off valve. These latter will be shown in standard form and of cast steel with monel metal trimmings for pressures up to 400 lb. Homestead protected seat hydraulic operating valves will be exhibited as used for operating hydraulic machinery of all kinds, and the protected seat operating valve with remote control of threeway and fourway types.

THE HORSBURGH & SCOTT CO., 5114 Hamilton Ave., Cleveland, O. Booth 455; Third floor.

Worm gear speed reducers, enclosed in oil tight and dustproof housing.

THE PAUL B. HUYETTE CO., 5 S. 18th St., Philadelphia, Pa. Booth 81-2; First floor.

In this exhibit will be included a full line of the P.B.H. apparatus, such as water gages, gage cocks, gage glass protectors, water columns and the Hays instruments for CO_2 testing and recording, also draft gages. General Electric flow meters will form a part of the exhibit. A new device recently put on the market is the P.B.H. adapter for making an inclined water gage out of one at present installed in vertical position. This adapter is attached directly to the regular vertical gage through the upper and lower water gage valves and gives a gage glass standing in an inclined position so that the fireman can read the water column from directly below. Another new device is the pointer draft gage developed during the past year which is of the membrane type with multiplied motion and adjustment for setting the pointer to zero.

HYATT ROLLER BEARING CO., Newark, N. J. Booths 497-8; Third floor.

Anti-friction bearings, as adapted for transmission equipment and for power plant and industrial machinery. The application will be shown to cranes, conveyors, trucks, motor fans and other power-driven machinery.

ILG ELECTRIC VENTILATING CO., 2850 N. Crawford Ave., Chicago, Ill. Booth 278; Second floor.

Exhibits on display will be a 50-in., direct-connected, multi-blade blower with 240-v., variable-speed motor held in a retaining ring direct-connected to the blower side. Also a factory unit heater of electric type, equipped with heating coils, a self-cooled motor propeller fan to supply air to this heating unit and fitted with a two-speed controller. These unit heaters can also be furnished with Aerofin heating coils for use with steam or hot water, and for ceiling suspension or floor mounting. Another item will be the Ilgair portable floor fan, for cooling foundries, steel mills and other "hot spots" in manufacturing plants.

ILLINOIS ENGINEERING CO., Racine and 21st St., Chicago, Ill. Booths 232-3; Second floor.

The special feature of this display will be a three-fourth in. No. 35 Eclipse steam trap in glass model form, operating under actual working conditions. It will show the instantaneous opening and closing of the valves, demonstrate the extreme separation of valve and seat when open and the impossibility of wire drawing or scoring of the seat. Included in the display will be a complete line of steam and vapor specialties.

IMPERIAL COAL CORP., 342 Madison Ave., New York, N. Y. Booth 771; Fourth floor.

Coals of all kinds and for all purposes will be shown here, together with charts showing analyses of the coals exhibited and evaporations and efficiencies obtained in actual tests. The classes shown will be coals standardized for all kinds of power plant equipment, bunker and cargo coals, locomotive coals, and domestic coals.

INGERSOLL-RAND CO., 11 Broadway, New York, N. Y. Booths 554-7; Third floor.

This company will exhibit a complete line of Cameron pumps and a series of enlarged charts showing the advanced features of Ingersoll-Rand surface condensers. In the pump exhibit a special feature will be a high-pressure, multi-stage centrifugal boiler feed pump for pressures up to 1500 lb. per sq. in. This will be equipped with a new and improved thrust device, consisting of a balancing drum to neutralize the rotor thrust and a Kingsbury thrust bearing on the outboard end. Another pump shown will be the class HW hotwell and condensate for pumping hot water under high vacuum conditions. The discharge is arranged so that stuffing boxes are under internal pressure, not vacuum. Special features of the condenser are the heart-shaped shell and tube staging with devaporization and air cooling carried on in a separate and distinct cooler.

INSTANT WATER HEATER CO., North Manchester, Ind. Booth 440; Third floor.

Heaters for instantaneous supply of water for house service.

INSULATING PRODUCTS CORP., 280 Madison Ave., New York, N. Y. Booth 437; Third floor.

Materials for insulating steam systems against heat loss.

INTERNATIONAL COMBUSTION ENGINEERING CORP., 43 Broad St., New York, N. Y. Booths 23-25A; First floor.

Unit systems for burning pulverized fuel will be shown including a No. 5 pulverizing unit with doors removed to show the design and arrangement of the rotor. The Lopulco pulverized fuel system will include a burner, a two-screw feeder and section of the air-cooled furnace wall, also a working model of the Raymond pulverizing mill. The CE furnace exhibit will show a section of furnace wall backed by the latest type of self-supporting wall of height to allow a view from above of the cross-section. Full-sized elements of the CE air heater will be shown and a Lopulco furnace boiler with electrical flame effect in natural colors. Various

stokers will be illustrated by drawings and the exhibit of detailed parts. Details of the Combustion steam generator will be shown, also a model to indicate by motion action just the way in which this generator performs its function.

INTERNATIONAL FILTER Co., 333 W. 25th Pl., Chicago, Ill. Booths 221-2; Second floor.

Working models will be shown here of chemical mixing, feeding and proportioning equipment, as used in International lime-soda water softeners. The special features will be a model of the International Crystalite water softener which uses the Zeolite process, and a working model of the International steam purifier. Photographs, charts and diagrams will illustrate water purification equipment and installation.

THE INTERNATIONAL NICKEL Co., 67 Wall St., New York, N. Y. Booth 9; First floor.

Monel metal and pure nickel in commercial forms will be shown, also a comprehensive display made of various parts of power plant equipment as regularly produced by leading manufacturers in this field. The forms will illustrate the uses of monel metal and its adaptability for especially difficult service in power plant apparatus.

IRVING IRON WORKS Co., Long Island City, New York, N. Y. Booths 438-9; Third floor.

In this exhibit will be found the Vizabledge Safstep which has a special double crimp near the nose of the step, thus aiding a person descending the stairs to see clearly the edge of the step. Standard Safstep construction will also be shown for stairs, platforms and runways.

D. O. JAMES MFG. Co., 1114 W. Monroe St., Chicago, Ill. Booth 735; Fourth floor.

Spur, worm and herringbone gear speed reducers, cut gears, rawhide and bakelite pinions, flexible and universal couplings.

THE JEFFREY MANUFACTURING Co., Columbus, O. Booth 473; Fourth floor.

This exhibit will cover the entire line of Jeffrey power plant equipment, including the pivoted bucket carrier, V bucket conveyor, belt conveyor, crushers, feeders and other equipment. A special feature will be motion pictures taken from typical Jeffrey installations and Jeffrey plants.

JENKINS BROS., 80 White St., New York, N. Y. Booth 90; First floor.

Jenkins Bros. globe, angle and check bronze and iron valves will be shown, also gate valves, bronze and iron types, radiator valves, and rapid action and self-closing valves. Included in the exhibit will be the Jenkins Bros. brand of mechanical rubber goods and the Moncrieff gage glasses. A feature of the exhibit will be a new line of iron body gate valves.

JOHNS-MANVILLE, INC., 292 Madison Ave., New York, N. Y. Booths 314-15; Second floor.

Raw asbestos and the processes by which it is converted into the products of this company, such as packings, power specialties, insulations, roofings and electrical materials, will constitute a major feature of this exhibit. Emphasis will be placed on the savings in power which can be accomplished by the proper use of asbestos as insulation, and also on the many ways in which it serves in the power plant.

JOHNSON SERVICE Co., Milwaukee, Wis. Booths 403-4; Third floor.

Details of temperature control system, for steam and hot water heating.

W. A. JONES FOUNDRY & MACHINE Co., 393 Seventh Ave., New York, N. Y. Booth 464; Third floor.

Products to be exhibited by this company are its spur gear and worm gear speed reducers and the miscellaneous power transmission appliances. The line will include a spur gear reducer set, and a worm gear high ratio reduction combination.

JUSTUS STEAM TRAP Co., Napanoch, N. Y. Booth 715; Fourth floor.

Steam traps and thermostats of the Justus make will be the features of the exhibit in this booth, both classes of devices being shown in detail and their actions demonstrated.

M. KATZENSTEIN & SON, 21 Ten Eyck St., Brooklyn, N. Y. Booth 625; Fourth floor.

Display will here be made of wiping material for cleaning machinery, including cotton waste, cheese cloth, sterilized wiping cloths, package products, mill ends and flannels.

THE E. F. KEATING PIPE BENDING & SUPPLY Co., Hartford, Conn. Booth 228; Second floor.

This company is planning to show samples of fabricated piping for high and low pressures, including various types of flanged joints, such as reinforced square corner Van Stone joints, welded flanges and nozzles, pipe bends, and samples of coil work as adapted to refrigeration chemical and drying processes.

E. KEELER Co., Williamsport, Pa. Booth 211; Second floor.

Here will be found an interesting model built especially for the show of a double duty type of Keeler boiler. There will also be models showing the circulation which takes place in the Keeler boilers, these models producing steam from opening until closing time each day, and a talk being given describing the construction of the boilers and the action during their operation.

THE M. W. KELLOGG Co., 7 Dey St., New York, N. Y. Booth 72; First floor.

Samples will be shown of forged welded tongue and groove flanged joints, both plain and with swivel type flanges, also a forge welded flue type pipe nozzle, Kellogg Van Stone pipe joint and Kellogg copper plated welded expansion joint.

KEYSTONE LUBRICATING Co., 21st and Lippincott Sts., Philadelphia, Pa. Booth 3; First floor.

Here will be found an interesting exhibit of a machinery unit equipped with the Keystone safety lubricating system. This will be in operation with the various accessories and methods of application being demonstrated. In addition will be shown Keystone Grease lubricants for speed reduction units and silent chain drives demonstrated by the use of a small unit in operation.

KEYSTONE REFRACTORIES Co., 120 Liberty St., New York, N. Y. Booth 11; First floor.

Methods of using Dura-Stix for bonding and extending the life of fire brick in boiler furnaces and the Keystone Sprayer for applying this steel-like veneer to furnace walls will be featured and demonstrated in this booth.

KIELEY & MULLER, INC., 34 W. 13th St., New York, N. Y. Booth 456; Third floor.

The exhibits here will include the regular line of pressure reducing valves, back pressure valves, steam traps, atmospheric relief valves, stop and check valves and new type low pressure air eliminator for vapor heating systems manufactured by this company. A special feature will be the Kieley marine trap for 400 lb. steam pressure.

KING REFRACTORIES Co., 1715 Niagara St., Buffalo, N. Y. Booth 95; First floor.

Mono boiler baffling and high temperature cement, Flame brand high temperature cements to meet various requirements of furnace construction.

KISSICK-FENNO Co., 53 Park Place, New York, N. Y. Booth 19; First floor.

This exhibit will cover the Copes boiler feed water regulator, made by the Northern Equipment Co. of Erie, Pa.; the Vulcan soot cleaner, manufactured by the Vulcan Soot Cleaner Co., Du Bois, Pa.; the CoKal stoker, manufactured by the CoKal Stoker Corp., Chicago.

KLINGERIT, INC., 16 Hudson St., New York, N. Y. Booth 317; Second floor.

Piston valves without seat or stuffing box, but with packing directly on the plunger, suitable for liquids, steam and gases. Reflex water gages and high pressure asbestos sheet packing.

THE KORFUND Co., 235 E. 42nd St., New York, N. Y. Booth 627; Fourth floor.

Korfund plates as used for the isolation of machinery of all types also a high frequency absorber will be included in this exhibit. This material is suitable particularly for machinery which runs at high speeds and is mounted on light foundations.

LEAD LINED IRON PIPE Co., Wakefield, Mass. Booth 10; First floor.

This company will exhibit galvanized and amalgamated lead-lined iron pipe and fittings for use on hot and cold water and especially adapted for boiler feed piping. Also will be shown acid-resisting lead-lined flanged pipe, fittings and valves for use with acids and in chemical work, tin-lined iron pipe and fittings and lead-covered copper tubing.

THE LEAVITT MACHINE Co., Orange, Mass. Booth 568; Third floor.

This company will exhibit its line of Dexter machines, including those for reseating of globe valves, of gate valves, and of pump valves. This line furnishes equipment by which the valves can be reseated while in the pipe line, regardless of the awkwardness of the location.

THE LEEDS & NORTHRUP CO., Stenton Ave., Philadelphia, Pa. Booths 432-4; Third floor.

Here will be found equipment for measuring and recording the operations in the power plant, including an electric carbon dioxide recorder for boiler room use, a new electric flow meter, which is unaffected by line voltage variation, a generator field temperature recorder, with automatic alarm contact, a frequency recorder, having open scale and a negligible temperature coefficient, a direct recording B.t.u. recorder for measuring and automatically recording the heat of boiler feed water, a remote station-load totalizing recorder, for giving continuous records of individual station loads, boiler water alkalinity controllers and surface condenser leakage recorders. A prominent feature will be the automatic combustion control for boiler furnaces which will be shown as a complete working demonstration for both powdered coal and stoker-fired plants.

LESLIE CO., Lyndhurst, N. J. Booth 678; Fourth floor.

Pressure regulators for marine and stationary service for either saturated or superheated steam for both high and low pressures. Reducing valves for steam, air and oil.

LIBERTY ELECTRIC CORP., Stamford, Conn. Booth 435; Third floor.

Operation of the Liberty Valve Operator will be shown by means of both local and remote switch button control, working on a 6-in., 600-lb. Pittsburgh gate valve. The demonstration will show the actual functioning of the safety clutch, which will exert a torque in excess of any normal amount required but will slip when the straining point of the valve is reached and thus prevent the breaking of valve stems. A cut-out control to show the functioning of all parts of the valve operator will also be exhibited.

LIPTAK FIRE-BRICK ARCH CO., Mexico, Mo. Booths 201-2; Second floor.

Arch and side wall construction will be exhibited showing adaptations for hand-fired, stoker-fired and pulverized coal furnaces. Of special interest will be single and double-suspended arches, self-supporting side wall construction of all refractory material and sidewalls based on the double suspended arch principle as adapted for powdered fuel burning.

LOCKE REGULATOR CO., Salem, Mass. Booth 445; Third floor.

This company will exhibit its controlling devices, including the Locke damper regulator, reducing valves, balanced valves and, as a special feature, its stop and speed limit system. The damper regulator is made in various sizes for control of the largest as well as the smallest dampers and, by means of a pilot valve, is so adjusted as to respond promptly to light changes in steam pressure.

E. G. LONG CO., 50 Church St., New York. Booth 735; Fourth floor.

This company, as manufacturers and direct factory representatives will exhibit the products of the D. O. James Manufacturing Co. of Chicago, including a number of models of spur gear type speed reducing transmissions, and a special combination worm and spur gear unit with driving motor. Also products of the American High Speed Chain Co., Indianapolis, including silent chain drives of various types and other types of power transmission chains, made by the Union Chain & Manufacturing Co. of Sandusky, Ohio.

THE LUNKENHEIMER CO., Cincinnati, Ohio. Booth 63; First floor.

Main features of this company's exhibit will be a 10-in., 400-lb., steel monel-mounted non-return valve and electrically operated steel monel mounted gate valve, equipped with Dean and Liberty controls. In addition to these will be shown a number of sectioned steel monel-mounted valves in the 6 in. size, also small steel monel-mounted and all monel valves in gate, globe, check and blow-off types.

MANISTEE IRON WORKS CO., Manistee, Mich. Booths 531-2; Third floor.

Here will be found an exhibit of the Roturbo pump, including an 8-stage horizontally split pump; a single-stage horizontal volute pump, with horizontal split casing and a Roturbo impeller mounted on a stand to show the details of construction.

MANNING, MAXWELL & MOORE, INC., 100 E. 42nd St., New York. Booth 60; First floor.

Its entire line of steam specialties will be exhibited by this company, including Ashcroft gauges, and specialties, Consolidated safety valves, especially those for high-pressure lines, Metropolitan injectors and Hancock valves in bronze, cast steel and forged steel types.

MARION MACHINE FOUNDRY & SUPPLY CO., Marion, Ind. Booths 209-10; Second floor.

The type AB soot blower and the valve-in-head independently operated, as used on water-tube boilers will be shown as it is installed in the boiler, illustrating the action of the blower in cleaning the tubes and of the valve-in-head controlling the blast. Another feature will be the Marion Gulfstream water heater for use in hotels, laundries and apartment buildings, or wherever a large quantity of hot water is desired.

MASON REGULATOR CO., Dorchester Center, Mass. Booth 223-4; Second floor.

Many features of special interest will be found here, including a complete line of pressure regulators, reducing valves, pump governors of both pressure and speed control types, hydraulic damper regulator, balanced and float valves, fan and stoker engine regulators, also standard bronze and iron body valves and high-pressure cast steel valves for the pressures now used in electric power generating stations.

MCCLAVE-BROOKS CO., Scranton, Pa. Booth 401-2; Third floor.

Shaking and dumping grates will be found in this exhibit and, as a special feature, type M-A stoker for small sizes of anthracite. Construction details will be shown and the operation of the stoker fully demonstrated.

MCLEOD & HENRY CO., Troy, N. Y. Booth 13; First floor.

In this display will be found fire brick, arches, blocks and high temperature fire cement, the method for which these are used for building up boiler settings will be shown. Special features will be the McLeod & Henry flat suspended arches and Steel Mixture veneer wall blocks.

MERCO NORDSTROM VALVE CO., INC., 110 W. 40th St., New York, N. Y. Booth 255; Second floor.

This entire exhibit will consist of modifications of the Merco Nordstrom lubricated principle as applied to plug cocks. Valves will be shown for power house use, for locations such as soot blowers, boiler blow-offs, feed water lines, steam lines; also new modifications and new types as well as three-way and four-way valves. An unusually large valve of either 12 in. or 16 in. full opening will be shown.

THE MERCON REGULATOR CO., 53 W. Jackson Blvd., Chicago. Booth M; First floor.

All types of Mercon pressure regulators will be shown, stress being placed on the main feature which will be actual working charts reproduced from those of the largest central stations in the country. These will show the smoothing out of steam and water flows and water level in the steam drum due to the use of the excess pressure regulator, in conjunction with the water level controller.

MERRICK SCALE MFG. CO., Passaic, N. J. Booths 237-40; Second floor.

Here will be found a conveyor scale in operation, weighing out actual material, also one of the company's recent productions, the Merrick Mechanical Weighman in operation, giving automatic record of the loads which pass across it.

L. R. MERRITT CO., 250 Park Ave., New York, N. Y. Booth 31; First floor.

Steam specialties and equipment of the various manufacturers which it represents.

MIDWEST PIPING & SUPPLY CO., 1450 2nd Ave., St. Louis, Mo. Booth 268; Second floor.

Midwest joints for superheated steam will be shown for pressures up to 900 lb., and temperatures up to 750 deg., these joints being of design which require neither gaskets nor field welding. An interesting feature will show a Midwest joint deflected 3 deg. and under a pressure of 2000 lb. to demonstrate that accurate alinement is not needed. Other features shown will be a modification of the Midwest joint for high pressure drip and drain lines, microphotographs and the results of tests on the metal in Van Stone, Sargol and Midwest joint laps as made by the company's process, and exceptionally short pipe bends which are being used to replace cast return bends.

MIXING EQUIPMENT CO., INC., New York, N. Y. Booth 716; Fourth floor.

Models will be exhibited of electric portable mixers for fluids, showing the various uses to which such mixers can be applied in industrial plants.

MOORE STEAM TURBINE CORP., Wellsville, N. Y. Booths 508-9; Third floor.

One of the exhibits in this space will be a 4-in., four-stage double suction boiler feed pump driven by a multi-stage steam turbine, a combination which gives efficient and reliable boiler feed. Also will be exhibited an oil relay governor and its hydraulically operated governor valve, the governor and oil pump being driven by an electric motor.

This will be a full sized governor, the same as used on 1000-kw. turbines, and will be arranged so that visitors can observe the operation of the governor in controlling the governor valve, with all detail of the movement.

MORSE CHAIN CO., Utica, N. Y. Booths 262-3; Second floor.

This will be an exhibit of silent chain drives of different sizes in actual operation. Samples of chains will be shown to demonstrate clearly the Rocker-joint construction and the efficient operation of this design.

THE MOTO METER CO., INC., Long Island City, N. Y. Booth 256; Second floor.

Motoco industrial thermometers will be shown and their adaptation for use in the power plant will be fully illustrated, also the economies which may be secured by keeping careful track of temperature will be explained.

MUELLER BRASS CO., Port Huron, Mich. Booths 407-8; Third floor.

Mueller brass and copper products will be shown here in the form of rods, tubes, forgings, castings and screw machine parts. A feature of special interest will be the Relleum brass forgings developed principally for the vital parts in automotive products, iceless refrigerators, hot water and steam heating appliances. These forgings as used in manufactured products will be an important part of the exhibit.

MURRAY CONDUIT SYSTEMS, 55 Duane St., New York, N. Y. Booth 300; Second floor.

This company's exhibit will include one of its latest monolithic conduit-forming machines, used in the housing of the highest underground voltages. Photographs will also be shown of installations of conduit in various parts of this country and Central America for both under ground systems and industrial buildings. The Murray system has a forming apparatus which builds the conduit in place in the case of parallel ducts with horizontal run, such as for underground construction. For station conduits, the ducts are made by the use of rubber forms laid before the concrete is poured and withdrawn after the concrete is partly set.

THOS. E. MURRAY, INC., 55 Duane St., New York, N. Y. Booth 301; Second floor.

Photographs and cross section drawings will here be shown illustrating the plants designed and installed by this company and the special features which it has worked out to secure the highest plant economy.

NASH ENGINEERING CO., So. Norwalk, Conn. Booth 66; First floor.

Jennings-Hytor vacuum and condensation pumps, for removing gases, air and condensate from heating systems; circulating pumps for hot water condensing systems and the Hytor sewage ejector.

FIG. 4. WHEREVER ONE TURNS, GRACEFUL DECORATIONS AND INTERESTING DEMONSTRATIONS WILL BE FOUND

THE NATIONAL ACME CO., Cleveland, Ohio. Booths 561-2; Third floor.

Here will be shown a new type of 4¼-in. single belt drive, single-spindle Gridley automatic turret lathe, driven by one broad belt or a single constant-speed motor. One set of gears is built into the headstock to change both spindle speed and feed at the same time with a second set by means of which the rate of feed can be changed independently. Also will be included a 1-in., five-spindle, high-speed Acme automatic screw machine of the latest model.

NATIONAL CO., INC., Cambridge, Mass. Booth 76; First floor.

Water column illuminators for lighting the glass from the opposite side, so that the level made be read at a great distance.

NATIONAL TUBE CO., Pittsburgh, Pa. Booths 8A-8B; First floor.

In this exhibit will be found samples of Shelby seamless tubing, National boiler tubes, National pipe, including the welding scale free pipe and the Van Stone flanges.

NAUGATUCK MFG. CO., Naugatuck, Conn. Booth 731; Fourth floor.

Seamless copper ball floats for receivers, tanks, steam traps, water columns and regulators in all shapes and styles, also pump air chambers.

NEEMES FOUNDRY, INC., Troy, N. Y. Booth 93; First floor.

Here will be shown a section of the Superior dumping grate, a section of the Improved shaking and dumping grate, and a section of the hand-operated stoker as built by this company. Full details of the construction and special features of these devices will be displayed.

THE NEW JERSEY ASBESTOS CO., 1 Water St., New York, N. Y. Booth 742; Fourth floor.

This company will exhibit the "V" Pilot Packing which is of semi-metallic form, specially designed for long service on steam, air, oil, ammonia, and hot and cold water installations. Other products shown will be the Gladiator brand of packings and Woodite products.

W. H. NICHOLSON & CO., Wilkes-Barre, Pa. Booth 92; First floor.

Here will be operated a Nicholson piston-operated steam trap showing a working model actuated by compressed air. The trap will have glass windows and sides to show operation clearly. In addition will be shown the Nicholson welded nickel steel float for high pressures and superheat.

NILES GEAR CO., 111 Broadway, New York, N. Y. Booths 457-8; Third floor.

This exhibit will be entirely on gears, particularly the Maag type, which is a complete system of involute gearing, having standardization by pairs. These will be shown in the straight spur, single helical and herringbone types. A unique feature of the exhibit will be hardened and ground spur gears, specially suitable for high speed reduction drives.

THE NITROSE CO., 1500 Peoria Life Bldg., Peoria, Ill. Booth 744; Fourth floor.

Nitrose, metal-coating paint will be demonstrated, its application shown and illustrations given of its value as a preservative for metal structures.

NORMA-HOFFMANN BEARINGS CORP., Stamford, Conn. Booths 279-80; Second floor.

Complete range of Norma precision ball bearings in all types manufactured will be shown, also a complete range of Hoffman roller bearings in various types. These will include the larger sizes for power transmission in units of various kinds and also the smaller sizes such as are used in machine tools. A device will be exhibited to demonstrate the anti-friction quality of bearings and one to show the amount of creep which actually takes place when the bearing is operating.

NORTHERN EQUIPMENT CO., Erie, Pa. Booth 19; First floor.

Chief among the features of this exhibit will be a moving display of the Copes boiler feed water regulator in operation, showing the relation between boiler load, water level and automatic control of feed water input. This will illustrate that the regulator at all times gives a definite feed water valve opening for a given boiler water level. The display will also include a condensate drainage control system, pump governor, valve movement indicator, and various sizes and types of control valves.

NORTON CO., Worcester, Mass. Booths 323-5; Second floor.

This company will show a complete line of silicon carbide boiler furnace refractories and cements, including a section of a boiler furnace wall with Crystolon bricks at the clinker line. These will be set with a special Alundum cement which, while enabling the mason to lay up a thin jointed wall, will mature under fire to a resistance equal to that of the bricks themselves. Complete section of a full size enameling furnace will be shown, illustrating the use of Alundum refractory material. Special shapes of hearth tiles, baffle bricks, hearth supports and other shapes will be included with the hearth plates and supports shown under heat in an electric furnace.

OAKITE PRODUCTS, INC., 22 Thames St., New York, N. Y. Booth 732-3; Fourth floor.

This company has made a special study of economical methods of cleaning oil coolers, surface condensers and other equipment and will show by a series of charts and blueprints the part that cleaning plays in connection with the operating efficiency of power plants.

THE S. OBERMAYER CO., Jefferson and Thomas St., Newark, N. J. Booth 260; Second floor.

Here will be found a complete line of refractory materials, including high temperature furnace cements and plastic monolithic material for furnace lining. Demonstration will be made of the method of applying the latter material for making repairs to furnace linings, and illustrations shown of results obtained from its use.

TINIUS OLSEN TESTING MACHINE CO., 500 N. 12th St., Philadelphia, Pa. Booth 318; Second floor.

Machines for testing hardness and ductility of materials and automatic balancing scales for testing the balancing of moving parts will be the features of this exhibit. Included will be the motor-driven Brinell hardness testers with proving rings, the latest Olsen automatic and autographic universal testing machine with eight speed reverse gear box drive, the Olsen-Carwen and Olsen-Lundgren static-dynamic balancing machine and automatic weight static balancing scale and connecting rod scales. The latter will be demonstrated for the first time at this show.

OTIS ELEVATOR CO., 260 11th Ave., New York, N. Y. Booth 57; First floor.

This exhibit will cover the products of the company made by the Commercial Steel Castings division, these castings being made entirely by the electric furnace process. An important feature will be a large valve weighing about 4,000 lb., which has been x-rayed and withstood a 200 lb. hydrostatic test. A number of smaller type control valves for high pressure and superheated steam work will also be shown also hardening of parts made from heat resisting compositions and magnet rings and spiders made of dynamo steel.

OXWELD ACETYLENE CO., 30 W. 42nd St., New York, N. Y. Booth 430; Third floor.

Exhibit will be made here of welding apparatus and equipment, all new lines of equipment being shown, and the details of construction and operation explained.

PALMER-BEE CO., 2778 Grant Blvd., Detroit, Mich. Booth 697; Fourth floor.

Mill type speed reducers and worm gear speed reducers, also flexible couplings and overhead all direction conveyors.

PAULSON-SPENCE CO., INC., 25 Church St., New York, N. Y. Booth 28; First floor.

Craig combustion control systems, water softening system.

PAYNE-DEAN CONTROL, THE CUTLER-HAMMER MFG. CO., 1253 St. Paul Ave., Milwaukee, Wis. Booth 16; First floor.

Control system for the operation of valves, either direct or by remote control.

PEABODY ENGINEERING CORP., 110 E. 42nd St., New York, N. Y. Booth 47; First floor.

This company will exhibit its product designed for the burning of oil, gas, pulverized coal, and also its viscosity regulators. These products will be shown in detail with drawings and blueprints of construction and of installations.

PEERLESS MACHINE CO., Racine, Wisc. Booth 405; Third floor.

This firm will exhibit and demonstrate one of its 6-in. and one of its 9-in. Universal shaping saws, both motor-driven, and will show their effectiveness in speeding up shop operations and reducing manufacturing costs.

HENRY PELS & CO., 90 West St., New York, N. Y. Booth 626; Fourth floor.

The display in this booth will be the triple combined machine which acts as a universal punch, splitting shear and bar angle and tee cutter. This machine is of special use in fabrication and construction work and is specially designed for the cutting and forming of structural shapes.

PENNSYLVANIA CRUSHER CO., Liberty Trust Bldg., Philadelphia, Pa. Booths 286-7; Second floor.

Working model of a Bradford coal breaker and cleaner, also a model of an Armorframe single roll crusher with photographs showing the specialized machinery for crushing.

PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa. Booth 522; Third floor.

Prominent in this exhibit will be a 3-in., 6-stage high-pressure boiler feed pump, suitable for pressures of from 300 to 500 lb. per sq. in., and having an opposed arrangement of propellers, which gives a practically balanced thrust. Constructions of the impeller wearing rings, the monel metal shaft sleeves and bushings and bronze wearing rings will be demonstrated, also the use of carbon packing at the high pressure seals.

PEORIA MALLEABLE CASTINGS CO., Peoria, Ill. Booth 735; Fourth floor.

Samples of castings of guaranteed quality also of detachable sprocket chain.

THE PERMUTIT CO., 440 Fourth Ave., New York, N. Y. Booths 3 and 28; First floor.

In booth 3, the principal exhibit will be a model of water softening and filtering equipment as used in industrial plants. This will be about 4 ft. long made exactly to scale, from a plant that delivers 100,000 gallons a day, pipes, strainers and tank having been reproduced in miniature. In booth 28 there will be exhibited the Ranarex instruments for recording carbon dioxide, gas density, ammonia gas, etc. These instruments operate on a purely mechanical principle. The operation is based on the specific weight of gas and, in the exhibit at booth 28, the construction and method of operation will be fully demonstrated.

PHILADELPHIA GEAR WORKS, Richmond and Tioga Sts., Philadelphia, Pa. Booth 10; First floor.

Here will be shown a full line of Philadelphia speed reducing units, of worm, spur, herringbone and spiral-herringbone types. Also a line of gears for various power plant uses.

PITTSBURGH PIPING AND EQUIPMENT CO., 43rd St. and A. V. R. R., Pittsburgh, Pa. Booths 401-2; Third floor.

Special pipe line construction and fittings will be shown here with photographs of numerous installations in power plants. Among the notable features will be welded headers, pipe expansion bends, line welds and examples of Sargol and Van Stone joints.

PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION CO., Pittsburgh, Pa. Booth 4; First floor.

Valves and piping for high pressures and high temperatures, will constitute the exhibit, the valves being cast steel with monel mountings, motor operated. Exhibit will also be made of welded headers, Atwood line welds and other Atwood specialties.

PITTS & KITTS MANUFACTURING & SUPPLY CO., 91 7th Ave., New York, N. Y. Booth 451; Third floor.

Here will be found a complete display of steam accessories including traps, reducing valves, feed water regulators, damper regulators, fan engine regulators, high and low water alarms, automatic safety water gages, gage cocks and the Bondite high temperature cement and Plastikote boiler wall covering.

PLIBRICO JOINTLESS FIREBRICK CO., 1130 Clay St., Chicago, Ill. Booth 93; First floor.

Plibrico furnace lining and monolithic furnace construction will be demonstrated in this exhibit. A special feature will be continuous moving picture showing the installation of a Plibrico lining in a 250-hp. oil-fired boiler, the picture starting with the ripping out of the old fire brick and ending with the furnace lining after a period of service.

The monolithic furnace construction is new at the show and has special features of monolithic design.

POOLE ENGINEERING & MACHINE CO., Baltimore, Md. Booth 467; Third floor.

Feature of this exhibit will be the Poole all metal flexible couplings, having internal gears on the coupling casing, meshing with gears on the end of each shaft hub. Also the herringbone speed transformer consisting of double herringbone gears, enclosed in a casing which is lubricated either by splash or pump system.

THE WM. POWELL CO., Cincinnati, O. Booth 495; Third floor.

This company plans to show a complete line of bronze, iron and steel valves, in globe, angle, cross, check and gate types for all working pressures and temperatures. The exhibit will also include lubricators, grease cups, oilers, water gages, whistles, injectors, safety, blowoff and non-return valves. The particular feature will be a large extra heavy steel valve with electric motor and push button remote control.

POWER SPECIALTY CO., 111 Broadway, New York, N. Y. Booth 20; First floor.

Samples will be shown of Foster superheaters, including convection and radiant types. Also samples of Foster economizer construction, sections of Foster water cooled furnaces and photographs of installations, drawing and typical small parts used in construction work. The Aero pulverizer will also be exhibited and demonstrated.

PREFERRED UTILITIES CO., INC., 33 W. 60th St., New York, N. Y. Booths 304-5; Second floor.

Here will be found the new Ray steam turbine fuel oil burner, also a 300-hp. electrically driven fuel oil burner with steam actuated oil and air controls. Other exhibits will be various sizes of the small Ray automatic fuel oil burner and the motor and control mechanisms.

PYRAMID IRON PRODUCTS CORP., 136 Liberty St., New York, N. Y. Booths 306-7; Second floor.

Pyramid grates and details of setting.

QUEENS RUN REFRACTORIES CO., INC., Lock Haven, Pa. Booth 569; Third floor.

The most important features of this exhibit will be standard 9-in. brick as used at present in boiler settings. There will also be shown special shapes of intricate design and some other brands especially adapted for heating furnaces and malleable iron practice. Qualities of the brick and its various uses will be fully demonstrated.

QUIGLEY FURNACE SPECIALTIES CO., 26 Cortlandt St., New York, N. Y. Booth 89; First floor.

Hytempite cement and its uses for the laying up of boiler walls, boiler baffles and the patching of furnace linings will be shown. The Quigley acid-proof cement for bonding of acid resisting masonry will be demonstrated, also the use of Ganisand for lining and repairing industrial furnaces or for making refractory tile and special shapes. Use of the Quigley refractory gun for making quick repairs on furnace linings will be illustrated and the method of protecting plant and equipment with triple-A protective coatings will be explained, also the results that have been obtained by such use.

RACINE TOOL & MACHINE CO., Racine, Wis. Booth 499; Third floor.

This company will show a new machine, the Racine Shear Cut production saw, with 6 in. capacity for high speed metal cutting. It will demonstrate the possibility of making cuts without increase in cutting time after the blade becomes dull. In addition will be shown standard models of Racine high speed metal cutting machines, motor-driven and in operation, as well as the Duplex band saw machine for cutting various kinds of metals.

RAMSEY CHAIN CO., INC., 1031 Broadway, Albany, N. Y. Booths 292-3; Second floor.

Silent chain drives with roller bearing and compensating joint chains.

READING STEEL CASTING CO., INC., Bridgeport, Conn. Booth 48; First floor.

Cast steel gate valves will make up the exhibit in this booth, special types of interest being a 4-in., series 15 valve with rustless steel trim, a 6-in., series 30 valve with rustless steel trim, a 6-in., series 40 globe valve with monel trim, a 12-in., series 40 gate valve with Dean control and monel trim, a 6-in., series 60 gate valve with ball bearing hand wheel and monel trim, a 4-in., series 90 gate valve with rustless steel trim, a 6-in., extra heavy iron body gate valve, a 6-in. iron body Underwriter's check valve and a series of bronze valves in globe, angle and check form, as well as asbestos packed cocks. A series of 15, 30, 40, 60 and 90 steel fittings will also be shown.

REED AIR FILTER CO., Louisville, Ky. Booth 466; Third floor.

The Reed self-cleaning air filter will be exhibited, showing the construction and action of the streamline filtering media and the arrangement of the three elements, the filter body, the distributor and the oil cleaner. A complete filter will be shown in operation, so arranged that it can be cleaned and recharged merely by pressing a button.

REEVES PULLEY CO., Columbus, Ind. Booth 39; First floor.

Variable speed transmission equipment with models showing construction, action and accurate variations of speed by an infinite number of steps.

THE RELIANCE ELECTRIC & ENGINEERING CO., 1042 Ivanhoe Rd., Cleveland, O. Booths 620-1; Fourth floor.

This company will exhibit alternating and direct-current electric motors of standard types, with both sleeve and antifriction bearings. Also it will display watertight direct-current motors and a special insulation for use where water, steam, dirt and acid conditions are unusually severe.

THE RELIANCE GAUGE COLUMN CO., 5902 Carnegie Ave., Cleveland, O. Booth 82; First floor.

Three Reliance safety water columns will be shown to illustrate the advance in steam pressure. One of these will be standard for pressures up to 250 lb. made of semi steel and equipped with copper floats, bronze seats and monel disc valves. The second will be of all forged steel for pressures up to 425 lb., equipped with nickel floats and monel seats and disc valves. The third will be standard extra heavy for working pressures up to 650 lb. equipped with special heavy duty all nickel solid shell floats and valves with monel seat and chrome-silicon discs. It will have an extra heavy flanged water gage with prismatic glass and Reliance chain-

operated gage cocks designed for 1500 lb. pressure. Sectional models will also be shown of the 1500-lb. gage cock, also of the 425-lb. gage cock and of high pressure and low pressure electric alarms.

REPUBLIC FLOW METERS CO., 2240 Diversey Parkway, Chicago, Ill. Booth 6; First floor.

This display will include the complete line of Republic instruments, including steam flow meters, water meters, air meters, gas meters, liquid level indicators and recorders, draft instruments, duplex and single record pyrometers, boiler meters and gas producer control equipment. Importance of the gas producer control in increasing the production in steel mills will be demonstrated by means of charts and diagrams.

RICHARDSON SCALE CO., Clifton, N. J. Booths 283-4; Second floor.

Model of a power plant with three boilers showing the use of coal weighing apparatus, one boiler equipped with automatic coal scale, for weighing coal from overhead bunker to down spout, a second weighing coal from overhead storage to the pulverizer, and a third with hand weighing larry for weighing from overhead bunker to stoker hopper.

RILEY STOKER CORP., Worcester, Mass. Booths 78-9; First floor.

A chief feature of the exhibit will be the Riley Atrita unit pulverizer in operation, showing the latest improvements which have been incorporated during the past year. A new mushroom flare type of pulverized coal burner will be shown, having air supplied at three different points, so that by manipulation of the dampers the shape, length and width of the coal flame can be regulated. In addition will be shown a two-retort Riley stoker which will be equipped with the latest type of grate blocks and a specially designed poppet valve to eliminate steam leakage, and replace the Cole valve, heretofore used with Jones underfeed stokers.

THE ROBERTS STEAM SPECIALTY CO., 5318 St. Clair Ave., Cleveland, O. Booth 548; Third floor.

Steam specialties will make up the exhibit in this booth, including safety water columns, forged steel water columns, floats of seamless copper, laminated steel and single wall steel, a water gage adapter for converting a vertical water gage into an inclined gage, illuminator or gage light for water gages, Diamond weighted lever gage cocks, and other specialties.

ROLLWAY BEARING CO., INC., Syracuse, N. Y. Booth 514; Third floor.

Heavy duty radial and thrust bearings of precision type will be exhibited, also representative bearings from the company's commercial line. Special feature will be samples of the Rollway line shaft bearings with adapter pillow blocks and similar fittings.

THE ROTO CO., Hartford, Conn. Booth 11-A; First floor.

Cleaning devices for boiler tubes and hand hole seats will be shown here, the special features exhibited being the Roto boiler tube cleaner, the Roto boiler hand hole seat scraper, cap cleaning machines and reseating machines. All these will be shown in various types and the method of operation demonstrated.

RUGGLES-KLINGEMANN MFG. CO., Salem, Mass. Booths 558-60; Third floor.

This company will display an extensive line of pressure and temperature regulating apparatus and also controlling devices for these. Special features will be a General Electric controller panel with an R-K motor-operated boiler feed line, differential-pressure controller mounted thereon. Also a balanced valve with interchangeable parts including chronometer, uniseat and double poppet valve. Another feature will be a dual motor step-action hydraulic regulator with both motors step compensated, also a class A temperature regulator with R-K multi-tube temperature element connected thereto. Other devices to be found in the exhibit will be motor-operated valves, high-pressure regulators, oil pump governor valves, temperature regulators, hydraulic regulators and a motor-operated furnace pressure regulator.

RUTHS ACCUMULATOR CO., INC., 292 Madison Ave., New York, N. Y. Booth 490; Third floor.

Because of the large size of the apparatus, only photographs of the accumulator can be shown in the exhibit, but the Ruths steam governors, which are an important part of the installation, will be displayed. It is the function of the accumulator to store steam during light load periods for use later in meeting peak loads, by introducing this steam into water under pressure. Heat energy thus stored is released in the form of steam at lower pressure, the governor forming the steam switchboard.

SARCO CO., INC., 183 Madison Ave., New York, N. Y. Booth 33; First floor.

Here will be shown the Sarco thermostatic steam traps, temperature regulators and strainers. As a special feature will be included the Sarco heating specialties for vacuum, vapor and pressure heating systems, including packless inlet valves and thermostatic radiator return traps.

SAUERMAN BROS., INC., 438 S. Clinton St., Chicago, Ill. Booths 520-1; Third floor.

The central feature of this exhibit will be a working model closely duplicating an actual coal storage yard at a power plant, illustrating a Sauerman power drag scraper taking coal from an initial pile alongside the receiving track and spreading coal out over the ground. It will show how this builds up a tightly packed pile to any desired height, also how the same scraper can be used to reclaim the stored coal and bring it back to the hopper.

SCHUTTE & KOERTING CO., 12th and Thompson St., Philadelphia, Pa. Booths 334-5; Second floor.

Here will be found the company's boiler feed injector of double duty type, in sizes from the smallest to the largest, and with a sectioned model to show construction. Reducing valves of the diaphragm actuated type will be exhibited, also the Schutte-Klinger piston valves, which are designed to act as stop and throttle valves, the piston sliding in a special lantern and friction rings of special packing. One of the features will be a multi-jet condenser, working on the Venturi principle, without the aid of an air pump and in operation so that the arrangement of the water jets can be seen. Another feature will be the generator air cooler, equipped with radial fin tubes to give maximum heat transferring surface. Rotary pumps of the geared type will be shown, using both spur and herringbone gears, the former with pressure balance feature and the latter with ball bearings for high speed. SK purifiers to eliminate water and dirt from steam before it leaves the boiler will also be demonstrated, and the construction shown by which water and dirt are caught and thrown into settling chambers.

SCOVILL MANUFACTURING CO., Waterbury, Conn. Booth 69; First floor.

For the power field special interest will be in the cup-drawn admiralty condenser tubes. For those who are interested in mechanical engineering, the exhibits will show the manufacture of the company's brass mill products, such as sheet, wire, rod and tubing, partly manufactured goods, such as special shaped rods, blanks and forgings as well as complete articles manufactured for other concerns.

THE "S-C" REGULATOR MANUFACTURING CO., Fostoria, Ohio. Booth 213; Second floor.

Included in this exhibit will be high-pressure and standard type feed-water regulators, pump governors and pressure regulating valves. Standard regulators for operation up to 400 lb. and high-pressure for 400 to 600 lb. will be a feature; also pump governors for pressures as high as 700 lb. The S-C Master control for special conditions handles reducing valves, pressures and boiler room equipment from a single station. The differential pressure regulating valves will attract much interest.

SCULLY-JONES & CO., 2012 W. 13th St., Chicago, Ill. Booth 752; Fourth floor.

Re-serviced machine tools and power plant equipment.

SEMINOLE CHEMICAL CO., INC., 75 Vesey St., New York, N. Y. Booths 217-18; Second floor.

System for cleaning of boilers, and keeping them clean of scale.

THE SHARPLES SPECIALTY CO., 23rd and Westmoreland Sts., Philadelphia, Pa. Booth 92; First floor.

Purification of oils will be demonstrated in this booth and the exhibit will consist of a No. 6 Presurtite Sharples Super centrifuge for the purification of fuel oil, a No. 6 portable Sharples apparatus for dehydration of transformer oil and the purification of lubricating oil, a No. 6 cross section machine to show the operating principles of the super centrifuge.

SHERWOOD MFG. CO., Buffalo, N. Y. Booth 244; Second floor.

Hart force feed oil pump, single and multiple feed, with adjustment for correct timing and flow.

JOHN SIMMONS CO., 110 Center St., New York, N. Y. Booth 519; Third floor.

Piping and accessories, also installations of piping in power plants which have been made by this concern.

SIMPLEX VALVE & METER CO., 68th and Upland Sts., Philadelphia, Pa. Booth 76; First floor.

Three instruments will be shown, to illustrate three steps

in the measurement of boiler feed water. First the simple manometer of the indicating type; second, the MPA meter of indicating and recording type; third the standard meter, which indicates, records and totalizes. The last type is the one generally used for measuring boiler feed, condensate, make-up water and for other similar uses.

SKF INDUSTRIES, INC., 165 Broadway, New York, N. Y. Booths 332-3; Second floor.

All types of ball bearings, covering radial and thrust, double row, self alining, bearings with balls and with rollers, applications of ball bearings to hangers, and pillow blocks.

SKIDMORE CORP., 1535 Dayton St., Chicago, Ill. Booth 700; Fourth floor.

Vacuum pumps for condensing and heating systems.

M. B. SKINNER CO., 558 Washington Blvd., Chicago, Ill. Booth 563; Third floor.

Exhibited in this space will be the Skinner pipe joint clamps, service saddles, pipe saddles, flange clamps and reseating tools. A feature will be the high pressure saddle clamp which is a new device of especially heavy construction and for use in confined spaces. Demonstrations of the use of the combined reseating tool will be made at the booth throughout the show.

F. L. SMIDTH & CO., INC., 50 Church St., New York, Booths 281-2; Mezzanine floor.

Merits of the Lenix short center belt drive will be demonstrated in two ways: First by means of a special model operating on the stroboscopic principle and consisting of three drives, two open and one Lenix, as nearly alike as it is possible to make them, and arranged to show visibly the power lost through the belt slip. Second a larger working model will be shown with prony brake, demonstrating the automatic action of the Lenix in responding instantly to peaks and valleys in the load applied to the driven pulley.

SMITH & SERRELL, Globe Indemnity Bldg., Newark, N. J. Booth 85; First floor.

This company, which makes a specialty of couplings, will exhibit the Francke flexible couplings as used on motor, turbine and engine drives for both direct connection and gearing. Five distinct types of couplings will be shown and several exhibits on direct connected shafts showing how accidental misalinements in angular direction and out of center are handled. Also how load shocks, vibrations and endwise displacements are taken care of. The five types to be shown are the improved bushed laminated-pin type, the double floating-ring type, the high speed type for turbine drives, the fractional horsepower type for small motors and high speeds and the marine type for connecting the engine or reverse gear shaft and the propeller shaft on boats.

SMOOT ENGINEERING CORP., 136 Liberty St., New York, N. Y. Booths 417-19; Third floor.

The Smoot control of combustion will be shown in operation by means of a gas-fired boiler completely equipped with its controls and operated under variable load conditions. Regulators will control the fuel and air supply to maintain a uniform steam pressure and constant CO_2 in flue gases. Load changes will occur every minute with the result that the regulating equipment will be active in adjusting the input of fuel and air. The master controller and regulators will be full size and will work exactly the same as in the operation of an actual plant. The Smoot feed regulator as applied to pulverized fuel feeders and stokers will also be shown in operation.

SNAP-ON WRENCH CO., 14 E. Jackson Blvd., Chicago, Ill. Booth 449; Third floor.

A complete line of Snap-on socket wrenches will be shown with all kinds of handles for turning nuts in all locations with ease and speed. This will cover sizes of hexagon and square nuts from $\frac{3}{8}$ to 1½-in.. The sockets have the feature of fitting on all sides so that they do not slip or mar the nut and the handles are made in combinations which can reach and turn nuts in locations impossible with ordinary wrenches.

FIG. 5. ECONOMICAL BURNING OF FUEL WILL BE ONE OF THE MAJOR FEATURES OF THE EXHIBIT

SOWDON & GREENE, 342 Madison Ave., New York, N. Y. Booth 500; Third floor, and 76, First floor.

Products of the Simplex Valve and Meter Co., of Ernst and Co., and of the National Separator and Machine Co.

THE SPENCER TURBINE CO., Hartford, Conn. Booth 452-3; Third floor.

Spencer turbo compressors will be exhibited for supplying air from 1 to 3 lb. pressure, as used in oil and gas burning furnaces, foundry cupolas, etc. Sizes of 7½-hp. and larger will be shown, which operate at the slow speed of 1750 r.p.m.

SPRAY ENGINEERING CO., 60 High St., Boston, Mass. Booth 533; Third floor.

Spray nozzles, strainers, flow meters, air coolers, washers and filters, paint guns, and the use of spray nozzles in spray pond cooling.

SPRINGFIELD BOILER CO., Springfield, Ill. Booths 31-2; First floor.

Water tube boilers and a working model of the Springfield boiler, with details of construction. Complete model of the

Hellgate Station of the United Electric Light & Power Co., New York City, where Springfield boilers are installed.

STANDARD STEEL & BEARINGS, INC., Plainville, Conn. Booth 336; Second floor.

Single and double row annular ball bearings and MRC thrust bearings will be shown in this exhibit with data covering the process of production and illustrations of the methods of manufacture and testing.

STANDARD TURBINE CORP., Scio, N. Y. Booth 451; Third floor.

Standard steam turbines in small sizes, ½ to 15 hp. for driving steam pumps and blowers, also in sizes up to 750 hp. for driving a.c. and d.c. generators.

STERLING ENGINE CO., 1252 Niagara St., Buffalo, N. Y. Booths 446-7; Third floor.

Two commercial type engines will be shown for driving pumps and generators and for various other mechanical service. These gasoline engines have counterweighted crank shaft dynamically balanced, which permits operation as high as 1200 r.p.m. Special attention has been given to the arrangement and attractiveness of the exhibit.

STERLING ENGINEERING & MFG. CO., 113 Business St., Hyde Park, Mass. Booth 28; First floor.

Operating demonstration of lifting trap also other traps and detailed parts.

STEWART-SAYERS CO., 50 Church St., New York, N. Y. Booth 26; First floor.

Oil purifying apparatus for handling engine and transformer oils.

STROM BEARING CO., 4527 Palmer St., Chicago, Ill. Booth 534; Third floor.

All types of Strom ball bearings will be exhibited including the radial single and double row, angular contact and thrust types. These will be shown in various sizes and an interesting demonstration made of the precision and accuracy of the construction of the bearings.

THE STRONG-SCOTT MFG. CO., Minneapolis, Minn. Booth 76; First floor. Booth 500; Third floor.

This exhibit will consist of a one-quarter scale working model of a 3000-lb. an hour capacity Unipulvo pulverizer. This unit will be complete in every detail and operated at full speed, but arranged so that every part of the mechanism can be inspected. Another feature will be the Unipulvo burner which employs a large discharge area, thus giving low entrance velocity, and has means for distributing and maintaining a uniform velocity across the width of the burner. A third feature will be a quarter scale working model of the company's coal dryer, built of cast iron and having a sectional or unit construction. Photographs, drawings and demonstration will be shown of the methods of burning pulverized coal.

B. F. STURTEVANT CO., Boston, Mass. Booths 411-414; Third floor.

In these spaces will be shown power plant equipment of the company's manufacture, including the Cindervane Fan, Lead-Coated steel-tube extended surface economizer, air economizer, turbine, Turbovane forced draft fan engine, and turbo undergrate blower.

The Lead-Coated steel-tube economizer gives protection against inside and outside corrosion. The air economizer has individual unit chambers which are removable so that those in the cold end can be changed to the hot end, thus lengthening the life of the machine. Turbines are suitable for direct connection for driving of fans, gas blowers and exhausters, centrifugal pumps and electric generators; the details of construction of wheels and buckets will be fully shown. Likewise the construction of the Cindervane and Turbovane fans will be shown in detail with full data as to their uses and performance records.

SUMET CORP., 1543 Fillmore Ave., Buffalo, N. Y. Booths 768-9; Fourth floor.

Here a demonstration will be carried out of a bearing running dry with no oil, heated to a high degree with the holder held in the hand of the operator. This is to demonstrate the properties of the Sumet metal as a bearing material.

THE SUPERHEATER CO., 17 E. 42nd St., New York, N. Y. Booth 56; First floor.

The feature of this exhibit will be units taken from superheaters in service for a number of years at the Hell Gate station of the United Electric Light & Power Co., New York, and at the Fordson Plant of the Ford Motor Co., Detroit, Mich. The exhibit will give excellent opportunity to study the results of operation at high temperatures and under severe operating conditions in these two leading plants of the country.

THE SWARTWOUT CO., Cleveland, Ohio. Booths 229-30; Second floor.

Special showing will be made of Swartwout ventilators, and a demonstration given of their application for actual boiler room ventilation. There will also be a working exhibit of Swartwout separators and other products, including the low-pressure float type and high-pressure bucket type of steam traps.

SWEET & DOYLE FOUNDRY & MACHINE CO., Troy, N. Y. Booth 477; Third floor.

Gas burners, gas furnaces and control valves for air and gas will make up the exhibit in this booth. There will be a small gas fired heat treating furnace, a large easel having mounted thereon several sizes of power gas burners, and as a special feature, a 2000-ft. capacity air gas proportional control valve, and a small working model of this valve, which actually proportions the air gas ratios and eliminates the human element in furnace operation.

C. J. TAGLIABUE MFG. CO., 18 33rd St., Brooklyn, N. Y. Booth 59; First floor.

The line of TAG apparatus will here be shown including the compensated mercury recording thermometer with spiral spring, inverted non-corrodible penarm and bulb and capillary tube in single piece. Other instruments will be the dial indicating thermometers, mercury thermometers with red columns, automatic controllers for temperature and pressure, oil testing instruments, hydrometers and clinical thermometers.

TAYLOR INSTRUMENT COS., Rochester, N. Y. Booth 507; Third floor.

Industrial thermometers and index thermometers of the dial type will be shown, for taking temperatures of feedwater, steam, flue gas and other fluids; recording thermometers for similar purposes with both single and double records will be shown, also combined recording thermometers and pressure gages. Temperature controls for use on desuperheaters, bleeder lines and storage tanks will be exhibited, aneroid and mercurial barometers, indicating and recording thermo-electric pyrometers for furnace and flue gases, long distance transmitting thermometers, a direct reading superheat indicator, mercury columns for vacuum and absolute pressure, and glass engraved stem thermometers for testing. Of especial interest will be the distance reading recording thermometer or pressure gage, which sends its indications through synchronized motors where it may be required. The direct reading superheat indicator, with moving scale to correct for the steam pressure is also an interesting novelty.

TECHNO-SERVICE CORP., 46 W. 40th St., New York, N. Y. Booths 265-6; Second floor.

Here will be found the Borsig valve in 8-in. size for 400-lb. steam pressure at 750 deg. steam temperature. This will be cut open in front to disclose the working parts and will be operated by a Cutler-Hammer motor control unit. Samples of Borsig special steel will also be shown as used in hammerwelded tanks. This steel has about twice the strength of ordinary welding steel at temperatures of 700 to 900 deg.

THE TERRY STEAM TURBINE CO., Hartford Conn. Booths 207-8-9; Second floor.

This company will exhibit steam turbines, reduction gears and flexible shaft couplings. The turbines will cover both single and multi-stage machines. Full details will be shown of the construction and operation of these machines and the uses of the reduction gears and couplings will be demonstrated.

THE TEXAS CO., 17 Battery Pl., New York, N. Y. Booths 748-59; Fourth floor.

Demonstration of the methods of preparing the Texas Company's lubricants and samples of its products.

THOMAS FLEXIBLE COUPLING CO., Warren, Pa. Booth 406; Third floor.

Adjustable shaft couplings.

TIDE WATER OIL SALES CORP., 11 Broadway, New York, N. Y. Booth 15-A; First floor.

Here the company will exhibit samples showing a complete line of its petroleum products, including power plant lubricants and greases. The booth will also serve as a rest room and information desk for friends of the company.

THE TIMKEN ROLLER BEARING CO., Canton, O. Booth A; Mezzanine floor.

Timken tapered roller bearings will be exhibited in detail and in all sizes for application to industrial uses. Also de-

vices will demonstrate the saving in power by the use of non-friction bearings. Features of the display will be Timken-equipped electric motors and Timken-equipped line shaft bearings.

TOPPING BROS., Verick and Van Dam St., New York, N. Y. Booths 527-8; Third floor.

Cored bar products, Detroit twist drills and Torchweld equipment. Simplex jacks.

TRILL INDICATOR CO., 34 E. South St., Corry, Pa. Booth 745; Fourth floor.

Trill outside spring indicators and continuous card indicators will be shown in operation, demonstrating the construction features and accurate results obtained. Included also will be the Trill check valve and Trill flushometers, also wire center indicator cord and an assortment of planimeters and three-way and straightway indicator cocks.

TRIPLEX MACHINE TOOL CO., 50 Church St., New York, N. Y. Booths 646-7, 661; Fourth floor.

This company's exhibit will include the Excello Tool and Manufacturing Co. of Detroit, Mich., grinding spindles and jig bushings, measuring instruments of the Geneva Physical Instrument Society of Geneva, Switzerland, and the jig boring machines and scientific apparatus of the B. C. Ames Co., Waltham, Mass.

20TH CENTURY WOODWORKER OF NEW YORK, INC., 303 Fourth Ave., New York, N. Y. Booth 740; Fourth floor.

In this space will be found the 20th Century Woodworker, and the Decora paint spray equipment. The former is a machine for all kinds of woodworking operations, including sawing, planing, jointing, boring, mitering, tenoning, and the like. The latter is a device for air brush painting on any surface and includes a gas-engine-driven air compressor of portable type operating without receiver tank.

UEHLING INSTRUMENT CO., 473 Getty Ave., Paterson, N. J. Booth 45; First floor.

Waste meter for showing the fuel wasted up the chimney by recording percentage of CO_2 and temperature of escaping flue gases on one chart. The record shows when soot was blown, when scale was removed and indicates bypassing of gases from leaky or broken down baffles. Uehling combined barometer and vacuum recorder.

UNION CHAIN & MFG. CO., Sandusky, O. Booth 735; Fourth floor.

Elevators, conveyors, steel chains, sprockets and buckets for ash and coal handling.

THE UNISHEAR CO., INC., 170 Fifth Ave., New York, N. Y. Booth 476; Third floor.

This company will exhibit its Unishear models A, and O, for cutting straight lines, curves and complicated designs in sheet metal and other materials, also the model B with cutting capacity of steel plates up to ¼ in. thick.

VASTINE SALES CORP., 205 W. Harrison St., Chicago, Ill. Booth 750; Fourth Floor.

Furnace fire observer for insertion in the door or sidewall of a furnace, permitting the boiler operator to observe the conditions of the fire and brick work at all times without admitting cold air into the furnace.

VINCENT-GILSON ENGINEERING CO., INC., 30 Church St., New York, N. Y. Booth 17; First floor.

This company represents the Diamond Power Specialty Corporation of Detroit, Andrews-Bradshaw Co. of Pittsburgh, Smith Gas Engineering Co. of Dayton, Ohio, Warren Steam Pump Co. of Warren, Mass., and the Carling Turbine Blower Co. of Worcester, Mass. Its exhibit will include the products of these various companies, the Diamond Soot blowers, the Tracyfier, for purification of steam, Smith gas producers, Warren steam pumps, Carling turbine blowers and the products of the Engineer Co. of New York.

FIG. 6. FEED WATER TREATMENT AND HANDLING, DRAFT, COMBUSTION AND FURNACE PROBLEMS ARE AMONG THE ENGINEER'S CHIEF INTERESTS

HENRY VOGT MACHINE CO., 10th and Ormsby St., Louisville, Ky. Booths 269-70; Second floor.

Drop-forged steel valves and fittings for steam or for hydraulic pressures up to 10,000 lb, per sq. in. on fittings and 6,000 lb. on valves.

THE VULCAN ELECTRIC BRAZER & WELDER CO., 107 E. 17th St., Paterson, N. J. Booth 634; Fourth floor.

This company will exhibit a new device, its electric brazing apparatus for band saw blades, which works from any 110 or 220-v. alternating current circuit.

THE VULCAN RADIATOR CO., 73 Homestead Ave., Hartford, Conn. Booth 714; Fourth floor.

Extended surface tubes will be shown made up in various units, such as radiators, hot blast heaters, heating cabi-

nets and so on. Samples will also be shown of all the various sizes of the tubing which the company manufactures made of different materials and combinations of materials. One of the most important features will be the extended surface heating system, demonstrating the effectiveness of extended surface as against prime surface.

THE VULCAN SOOT CLEANER CO., Du Bois, Pa. Booth 19; First floor.

Here will be found the Self-contained Vulcan valve operating head. Also the Vulcan ratchet operating head, both of them new developments for the control of operation of soot cleaner installations.

The Crodon and Super-Crodon blower elements will also be shown, which by the use of a chrome alloy are given protection against sulphur gases and corrosion.

WAILES-DOVE-HERMISTON CORP., 17 Battery Pl., New York, N. Y. Booths 296-7; Second floor.

Materials and methods for lining coal and ash bunkers with tile, also Bitumastic and Hermastic paint and enamels for the prevention of corrosion of metal surfaces.

WAITE DAVEY & CO., INC., 5 Court Square, Long Island City, N. Y. Booth 58; First floor.

Suspended arches, air-cooled side walls and rear combustion arches, the air being heated in the side walls as high as 500 deg. F.

THE WALSH & WEIDNER BOILER CO., Chattanooga, Tenn. Booths 250-1; Second floor.

Seamless forged steel sectional headers as used in the company's water tube boiler, and other constructional features as demonstrated by detailed parts, drawings, photographs and models.

WALWORTH CO., Boston, Mass. Booths 308-11; Second floor. 44A; First floor.

A general line of brass valves and tools will be shown by this company, also its pipe fittings and regular line of steel and iron-bodied valves. A special feature will be the Sigma steel gate valves for very high pressures and temperatures up to 900 lbs. Testing of Kewanee unions with compressed air under water will be demonstrated. Exhibit will be made of Stillson wrenches and parts.

WARREN STEAM PUMP CO., Warren, Mass. Booth 231; Second floor.

This company will exhibit its centrifugal pumps and reciprocating pumps, showing the details of their construction and demonstrating the effectiveness of their action.

WARREN WEBSTER & CO., Trenton, N. J. Booths 225-6; Second floor.

This exhibit will be of unique and educational character, showing the latest developments of the company's products in the field of the vacuum and modulation systems of steam heating. These two basic types of systems will cover all phases of low pressure steam usage. A new feature of the exhibit will be stressed, namely the handling of condensation and air through process steam apparatus in its many varied applications. The central part in this part of the exhibit will be the improved equipment which makes possible quicker handling of condensation and air through apparatus using steam at pressures up to 100 lb. per sq. in.

THE WATSON-STILLMANN CO., 75 West St., New York, N. Y. Booths 772-3; Fourth floor.

Steam specialties and equipment, also hydraulic equipment, including valves, fittings, accumulators and pumps.

WESTINGHOUSE ELEC. & MFG. CO., East Pittsburgh, Pa. Booths 387-9; Third floor.

Here the company will exhibit a 7½-kw. turbine generator, consisting of an 02 ENC turbine, and 250-v. generator unit; also will be shown a 2 AMD turbine, a 150-kw. geared turbine generator with 5 HNC turbines and a 150-kw., 250-v. generator, compound wound to run at 900 r.p.m. Micarta gears in their various sizes and types will also be on exhibition.

WESTON ELECTRICAL INSTRUMENT CORP., Newark, N. J. Booths 510-11; Third floor.

Switchboard rectangular meters, speed indicators, and a full line of portable precision instruments will be shown in this space. Methods of installing switchboard instruments will be demonstrated and the convenience and accuracy of indication of the portable types will be shown.

C. H. WHEELER MFG. CO., Lehigh and Sedgley Aves., Philadelphia, Pa. Booth 77; First floor.

Here will be found a 2-stage Radojet air pump, a new type of twin drain control for removing condensate from the inter and after condenser, a three-stage Radojet pump with two barometric intercondensers for a vacuum of 29.8 in. with injection water of 70 deg. Also a number of photographs of condensers, regulating pumps and different types of Radojet air pumps and of complete installations.

WHEELER CONDENSER & ENGRG. CO., Carteret, N. J. Booth 64; First floor.

The chief feature of this exhibit will be a model of a surface condenser equipped with special valves for reversing the water flow and thus cleaning the condenser. The company will also exhibit some of its smaller apparatus, such as the steam jet air pumps, hotwell pumps, expansion joints and a cross-sectioned model of one type of evaporator. Numerous photographs and slides of the larger Wheeler equipment will be shown.

THE WHITNEY MFG. CO., Hartford, Conn. Booth 249; Second floor.

A moving exhibit covering the three principal lines of Whitney chains for power transmission will be shown. These are the double bearing pin and bushing type of silent chain for moderate speeds and heavy loads, rolling joint type of silent chain for high speeds with minimum lubrication, standard steel roller chain designed for heavy loads at slow speeds.

THE D. E. WHITON MACHINE CO., New London, Conn. Booth 471; Third floor.

Four sizes of Lee steam turbines will be shown, one with the cover raised to permit of study of interior construction. The Lee boilerfeeder turbine will be exhibited equipped with the follow-up governor, emergency overspeed stop and no-water stop. The follow-up governor automatically varies the turbine speed to maintain a constant excess pressure above boiler pressure and is an addition to the constant speed governor. The emergency overspeed stop shuts down the unit in case of accidental overspeeding and the no-water stop will close down the unit should the suction water supply fail, thus preventing a burned-out pump. The Lee patented efficiency reversing chamber and Lee shaft packings will also be shown.

THE WICKES BOILER CO., Saginaw, Mich. Booth 285; Second floor.

A lantern slide machine with views of construction in the shop of various types of boilers, also views of many different installations will be provided for the instruction of visitors. Blueprints and photographs will illustrate the details of the boilers, and literature will be available describing the various types which the company manufactures.

WILSON WELDER & METALS CO., Wilson Bldg., Hoboken, N. J. Booths 485-6; Third floor.

This company will display its type S welding machine with plastic arc gasoline engine-driven generator in portable form. Also it will show a complete line of Color-tipt welding wire and welding accessories for use in all kinds of welding operation.

L. J. WING MFG. CO., 352 W. 13th St., New York, N. Y. Booth 61; First floor.

Blowers, exhausters and fans will make up the exhibit in this booth. A Wing turbine blower, for stokered and hand-fired plants will be shown, with the method of installation by cutting a hole in the boiler wall, thus giving individual forced draft for each furnace. A motor-driven blower will be shown for use in low-pressure heating boilers, which can be set either direct in the boiler wall or with the blower discharge connected to the ash pit; this device can be fitted with a speed regulator and also an automatic regulator for turning the blower on and off to maintain constant room temperature. Low ceiling type of featherweight unit heater will be shown, for delivering air at the working level, from units installed overhead. The Wing Scruplex exhaust fan, with intake top, bottom, right or left, horizontal or vertical, and with the motor removed from exhaust housing will be exhibited, also the Scruplex fan of propeller type for delivering air in straight parallel lines.

WISCONSIN ELECTRIC CO., Racine, Wis. Booths 766-7; Fourth floor.

High-speed precision grinders, drills and floor motors of less than 1 hp. will be included in this exhibit. The special features will be the line of precision grinders, with their operation in close finishing of machinery demonstrated during the show.

T. B. WOODS SONS CO., Chambersburg, Pa. Booth 529; Third floor.

Power transmission appliances, especially "U.G." automatic belt contactors, flexible couplings, and Wood-Fafnir ball bearing hanger boxes.

WORTHINGTON PUMP & MACHINERY CORP., 115 Broadway, New York, N. Y. Booths 555-7; Third floor.

Diesel solid injection oil engines, type OS centrifugal pumps, feather-valve air compressors, vertical air compressors, Dean power pumps, water and oil heaters.

WRIGHT-AUSTIN Co., 315 W. Woodbridge St., Detroit, Mich. Booth 236; Second floor.

This company will exhibit a line of specialties for the boiler room and the piping system, featuring particularly its Crescent weighted try-cock and the water gage with the glass replacing union, which has not heretofore been exhibited. Chain-pull water gages and try-cocks will also be shown and the company is promising a new product which will be a surprise to the engineering profession and, it is asserted by them that it will be of the greatest interest.

"X" LABORATORIES, 25 W. 45th St., New York, N. Y. Booth 259; Second floor.

Here will be exhibited "X" boiler liquid for repairing steam and hot water boilers of high and low-pressure types.

THE YALE & TOWNE MFG. Co., Stamford, Conn. Booths 622-3; Fourth floor.

This company's full line of equipment for power plants will be shown and demonstrated, including the Yale ball bearing chain block in sizes from ¼ to 20-t. capacity; the Yale screw-geared chain block, in sizes from ½ t. to 5 t., especially for portable use; Yale differential chain block, in sizes from ¼ t. to 2 t., for use where the heavier types are not needed; Yale ball bearing electric chain hoist, capacities from ¼ to 2 t., for push button or manual control; Yale pressed steel crane ends, for supporting the block, beam and wheel axles of a traveling crane, and Yale trolleys in capacities from ¼ t. to 20 t. for the carrying of the hoist on crane beams.

YARNALL-WARING Co., Chestnut Hill, Philadelphia, Pa. Booths 7A-7B; First floor.

Yarway blow-off valves for all working pressures, including the recently-developed type C valves with protected packing features for working pressures of 900 lb. per sq. in. will be shown. In operation will be a Yarway Lea V-Notch recording liquid meter giving continuous readings of water flowing through a sectioned tank with hook gage attachment for checking the meter reading. This hook gage will be of the type furnished the Richmond Station of the Philadelphia Electric Co., which has guaranteed accuracy of ½ of 1 per cent. A typical group of Yarway involute spray nozzles will be shown and a special type of spray nozzle for use in aeration of water to remove objectionable tastes and odors.

Combination Furnaces for New General Motors Plant

REFLECTING the business-like activity of the automobile industry, excavation work on the General Motors Corp. new $1,000,000 power plant at Flint, Mich., was recently started on the same day that contracts were signed. All engineering work was handled entirely within the organization, less than three months elapsing from the time of the preliminary surveys to the signing of the contracts.

Six 720-hp. Heine boilers will furnish steam for heating, dry kiln, process work and driving air compressors. Three of these will be served by Taylor stokers with coal distributed by a weigh larry from an overhead bunker and ash handled by a steam jet conveyor.

The remaining three boilers will be set over a combination pulverized coal and sawdust furnace, with air cooled walls, Bigelow arch and a Combustion Engineering Co. unit pulverizer. Arrangement of the air ducts and dampers is such that preheated secondary air enters the furnace directly under the coal burner when coal is being burned or through tuyeres near the bottom of the furnace for sawdust. Experience has proven this method of supplying air to these furnaces to be much more satisfactory than the use of a grate. Furnace volumes on these new furnaces run approximately 0.6 cu. ft. per sq. ft. of boiler heating surface and combined with a perfected sawdust stoker to give an absolutely uniform feed has demonstrated the possibility of smokeless combustion at 250 per cent rating.

Flexibility of the unit pulverizer and its ability to meet load changes instantaneously makes it superior to the stoker fired combination furnaces formerly used.

In design the combination boiler is similar to the one in the boiler room addition to the Fisher Body plant at Pontiac, Mich., where three 1000-hp. Heine boilers have been installed to meet the needs of the new home of the Pontiac Six. The other two new boilers for coal are stoker fired and the three will bring the rated capacity of this plant to 7000 hp. stoker fired boilers, three for coal only and one for coal and sawdust.

At Flint a remarkably flexible loop arrangement of feed water piping and of steam piping both within the power house and throughout the plant makes it virtually impossible to curtail shop production due to failure of piping in any part of the system. In the future two more boilers will be added and the building, including the 265 ft., 14 ft. diameter at top, stack, has been laid out with this in view.

Water for fires or emergencies is provided by a large elevated tank and another ground storage reservoir. Draft gages, CO_2 instruments, indicating pryometers and flow meters will be provided for the boiler room. General Electric Co.'s electric type flow meters will be used throughout the plant with a panel of 22 recorders and integrators located in the chief engineer's office.

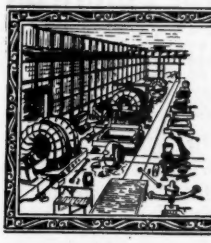
Hot water heating will be provided by four heaters with individual pumps while the boiler feed system will consist of three centrifugal pumps and two 5000-hp. open type heaters. No electric current will be generated.

Many years' practical experimental work of one of the simplest and most efficient industrial power plant organizations in the country has been incorporated in the design and steam production costs are expected to set a low mark among other plants of the organization who are even now producing steam at costs comparable to large central station systems.

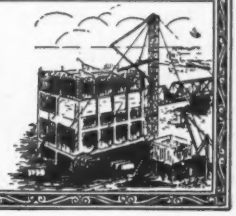
U.S.G.S. Reports Public Utility Power Production

ACCORDING TO the report of the Division of Power Resources of the U. S. Geological Survey, Department of the Interior, the public utility power plants in the United States in August this year produced 6,120,232,000 kw-hr. of electric power, an increase of 12 per cent over production for August, 1925. The July, 1926, production was 5,914,284,000 kw-hr., an increase of 10 per cent over July of last year. The middle Atlantic section of the country produced 1,630,368,000 kw-hr. of this August total.

Of the above amount produced in August, 1926, 2,089, 743,000 kw-hr. were produced by water power. In the production of electric power by fuels in August, 3,451,499 short tons of coal were burned, together with 753,955 bbl. of fuel oil and 5,407,642,000 cu. ft. of natural gas. The average daily consumption of fuels in August, 1926, was 111,300 t. of coal, 24,000 bbl. of oil and 174,400 cu. ft. of gas. The report gives these figures in detail by states and shows an interesting curve of average daily production.



POWER PLANT ENGINEERING DEVELOPMENTS AND NEWS



Large Atmospheric Relief Valve for Hudson Ave.

THE EDWARD Valve & Manufacturing Co. of East Chicago, Ind., has recently completed an atmospheric relief valve of huge proportions for the Hudson Avenue Generating Station of Brooklyn Edison Co. This valve,

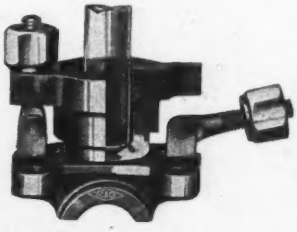
THIS 48-IN. ATMOSPHERIC RELIEF VALVE SERVES AN 80,000-KW. TURBINE AT HUDSON AVE.

shown in the accompanying view, is a 48-in. unit and will be used in conjunction with the 80,000-kw. turbine generator set to relieve pressure in the 80,000-sq. ft. surface condenser should the vacuum fail and the unit go non-condensing. Both hydraulic and manual operation were provided for by means of a hydraulic cylinder and an operating yoke mounted on top of the valve. The complete valve weighed approximately 23,000 lb. and was 17 ft. 5 in. high over all.

BOSTON TRANSIT COMMISSION has received bids for a power station to be erected in connection with the electrification of the Tunnel extension. The bids range from $17,830 to $26,000.

Gage Cock Designed to Reduce Gage Glass Strains

AS A RESULT of the strains put upon gage glasses not only while they are in use but also while they are being installed, gage glass breakage sometimes becomes a constant annoyance and expense to operators. A gage cock put on the market by O. C. Keckley Co., Chicago, Ill., is designed to relieve any gage glass strains that may be caused by the twisting of gland nuts when installing and by the expansion and contraction of glass and metal parts when operating.



GLAND SLIDING OVER STUFFING-BOX IS HELD ON GASKET BY WING NUTS

In the accompanying illustration are shown the principal features of the stuffing-box which is the distinguishing feature of this cock. Instead of a threaded gland to screw down on the packing, a sliding gland is used, held down by wing nuts as shown. This gland bears on a thick rubber gasket, which has a thin projecting lip designed to be forced out against the gage glass by the steam pressure. The hole in the gland is larger than the gage glass so that the two are not in contact. The whole device is designed to permit replacement of a gage glass quickly and without the use of tools.

This gage cock is made for high pressure work from a solid steel block and is also supplied in brass for average pressures and in flanged and screwed types. The cock itself is the same in construction as is ordinarily used. The unit has already found many applications in pressure still work in the oil refineries, as well as to boilers.

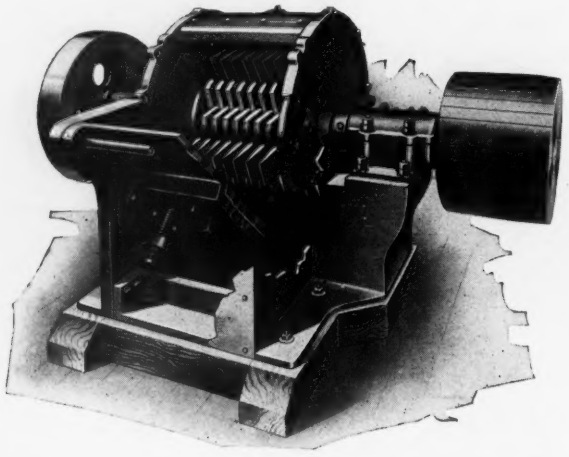
Hammer Crusher for Soft Coal

FOR CRUSHING and preparing mechanical stoker coal the Williams Patent Crusher & Pulverizer Co., St. Louis, Mo., has developed the "Jumbo Junior" crusher. The patented swing hammer construction of larger crushers has been retained with the hammers made wedge shape to split, rather than crush, the coal.

In this manner a product with a minimum percentage of fines is obtained, making uniform firing possible.

Renewable breaker plates with wedge adjusted, sectional chilled iron or Manganese steel liners can be moved, by adjusting screws, to give the size product desired. Wear in the plates and hammers can be taken up by the same adjustment screws or by moving the hammer pivots radially on adjustable disks. No grate or screen is used, the coal passing directly over the breaker plate without requiring a screen and bypass arrangement to separate fines or slack coal before crushing. As other sized coal can be run directly through the crusher even when idle, no bypass is necessary under any condition and the installation can be considerably simplified by omitting this detail. Tramp iron passes directly through without causing damage or requiring a magnetic separator.

Two liberal ring oiled babbit bearings are provided and driving shocks eliminated by using a heavy flywheel. Either belt or direct motor drive can be used



THE ROTATING WEDGE HAMMER OF THIS CRUSHER SIZES COAL WITH A MINIMUM OF FINES

to meet local requirements of space and power. Capacities of from 50 to 500 t. of 1¼-in. coal can be handled per hr. with the six sizes, power requirements ranging from 20 to 125 hp. for the range of capacities given.

Proposed Merger of Indianapolis Utilities

TENTATIVE plans are under way for a merger of the Indianapolis Light & Heat Co. and the Merchants Heat & Light Co., both operating at Indianapolis, Ind., the consolidated organization to be capitalized at $40,000,000 to $50,000,000. The first noted was recently reorganized with Norman Perry as president, and Walter Marmon as chairman of the board; the Insull interests of Chicago lately acquired about 28 per cent of the common stock of the company. The Merchants Heat & Light Co. is an Insull-owned utility, being operated by the Central Indiana Power Co., a holding company. Following the proposed consolidation, it is planned to make a number of improvements and extensions, with inter-connection of lines of the two utilities.

Management Meeting Devoted to Waste Elimination

"ECONOMIES in intangibles" was the subject of the address of one of the speakers at the "Management Week" dinner meeting held in Chicago on Oct. 28. The speaker, John W. Thomas, vice-president of the Central Trust Co. of Illinois, after defining waste as the unnecessary expenditure of time, energy, material and money, developed many ideas that apply as well to power plants as to manufacturing establishments.

Speaking of simplified practice he said one of its results has been "the willingness on the part of individuals engaged in the same line of industry to exchange information, resulting in the elimination of duplication of effort, with its resultant waste." Much benefit would be derived by all who are connected with power plants if cost data were as freely released as are manufacturing data in industrial practice.

Speaking of intangible wastes, such as would apply to unused or little used equipment, he mentioned the losses due to interest on investment, maintenance cost and obsolescence. "One of the greatest problems in plant management," he said, "is the proper amount of plant investment. The proper policy is to intensify in the use of equipment until it has been proven that the additions contemplated are really necessary. No phase of the problem has caused more waste than excess equipment."

"Excess inventory," he also said, "entails a direct and considerable waste, through unnecessary expenditure on that amount of the inventory that is in excess of requirement for prompt delivery or turn-over."

In order to determine correct action regarding these matters, the speaker emphasized the need of adequate records and cost data but cautioned against the installation of "systems to the superlative or nth degree," reminding his hearers of the loss involved in maintaining a too highly refined system.

Harold V. Coes, vice-president and general manager of the Belden Manufacturing Co., speaking on the subject "Management's Part in Waste Elimination," emphasized the establishment of a budgetary control, indicating how this kept down unnecessary expenditures in both equipment and materials and reduced operating costs. He said a budget should "set standards, provide incentives and force pre-planning," all of which tend to reduce wastes.

Mr. Coes also said, "What management needs is indicators to show the presence or absence, increase or decline of business ailments. Management needs means for control." He pointed out how these features may be accomplished by the development of proper records and the establishment of adequate management.

William L. Abbott, chief operating engineer of the Commonwealth Edison Co. and president of the American Society of Mechanical Engineers, spoke of some of the reasons why American industries and workers were in a prosperous condition while foreign industries are suffering so severely. He said, "The American worker does his utmost to do all he can and has greater interest in his work because of this. He is aided in this direction by incentives of pay, facilities for performance and improved conditions of working."

Herman Kiefer Hospital Builds New Power Plant

UPON COMPLETION of the concrete foundations, structural steel work on the new $750,000 power plant of the Herman Kiefer Hospital, Detroit, Mich., is being carried forward with all possible speed in order to have it ready for operation by March of next year. Designed by Albert Kahn, Inc., the plant will supply steam for the hospital laundry and refrigeration system, as well as for heating. Being a municipal institution, electric power will be taken from the municipal electric light system rather than installing generating equipment in the new plant.

Four 400-hp. Stirling boilers with 6 by 12 ft. underfeed stokers and forced draft will be served by a weigh larry from overhead bunkers. Coal as received will be dumped into a track hopper and fed through a roll crusher to a combination bucket belt conveyor system for distribution to the bunkers. Ash will be handled by the same bucket conveyor and deposited in an ash bunker located directly over the track.

Water for boiler feed and laundry purposes will be treated in a 10,000-g.p.h. hot process treater while refrigeration, ice and ice cream plant requirements will be met by a 50-t. ammonia compressor. Boilers, laundry and refrigeration equipment will be housed in a single structure, with an ornamental octagonal stack built to harmonize architecturally with the other buildings.

Repairing Baffles by Use of Refractory Gun

By P. R. Inglis*

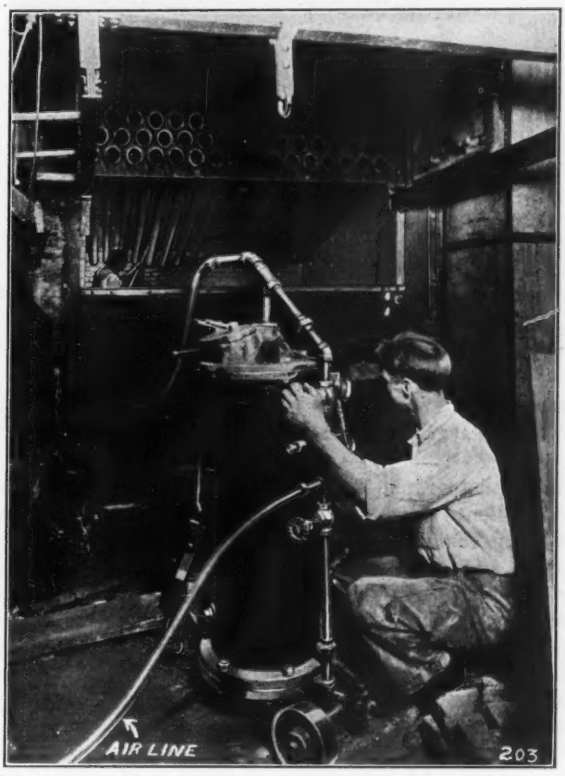
LEAKY BAFFLES that have given trouble for some time at our Bronx plant have been repaired by shooting plastic refractory mixture on them.

Three 400-hp. B. & W. boilers supply the power in this plant for operating all equipment and for heating. Owing to the limited number of boiler units it is necessary that they operate at high efficiency, but considerable loss was found due to leaky baffles. Efforts to seal the leaks by hand methods were unsuccessful, so it was decided to try the Quigley refractory gun for this purpose.

We first repaired the front baffle on one of the boiler units, using a mixture of crushed, old fire brick and "Hytempite." Using a ¾-in. nozzle, 4 ft. long, we worked up between the tubes in the first pass and applied the mixture, first in one diagonal direction and then in the other. By this means we reached the entire front surface of the baffle. Slight turns of the nozzle, right and left, while shooting the mixture, completely sealed the cracks and spaces around each tube. The bridge wall, which had an irregular crack 2 in. wide through its middle, was also repaired by this method.

Repair work was started 4 hr. after the fire had been drawn and all repairs to bridge wall and baffle completed in about 2½ hr. Fire was again started as soon as the job was completed and an immediate improvement in furnace efficiency was noted.

In the adjoining boiler unit, the lower part of the front tile baffle had just been rebuilt and a new stoker installed. It was decided to treat this entire baffle, both new and old, with plastic refractory material. To reach this surface, the plastic material was forced to the nozzle through 40 ft. of hose. We also repaired the rear baffle, in the same boiler, to save rebuilding it. The working space was small as the distance between the top row of tubes and the drum was only about 2½ ft. Sixty feet of hose, with a 4-ft. nozzle was used and the repair-work accomplished from above by bringing the hose around the boiler and through the upper clean-out door. The speed of application and the high grade of work done by our own men astonished the writer.



SHOWING GUN SHOOTING PLASTIC MIXTURE ON BAFFLES AND APPARATUS FOR REGULATING PRESSURE REQUIRED

Specially prepared crushed old fire brick, higher in cost than the average, was used and the mixture was composed of five parts of this material and three parts of "Hytempite" which was mixed in a mortar box, after first adding two parts of water to the latter. The mixture was well stirred and then the crushed fire brick, which had been screened through an ⅛-in. mesh and including fines, was added. The gun operator adjusted the valves until the mixture flowed freely through the hose, after which the contents was discharged automatically. The starting pressure, which was 80 lb. per sq. in., dropped when the gun was operating to 60 lb. per sq. in. The entire cost of the plastic mixture amounted to about 2c per lb.

*Power Plant Superintendent, Bronx, N. Y., Plant, Ward Baking Co.

Electric Arc Increases Life of Turbine Runners

By A. F. Davis*

EROSION of water wheel blades may be effectively repaired by the use of the electric arc welding process. Metal worn away by the combined action of the water, cavitation and grit is replaced by the welding process to make the wheel as good as new.

Work being carried on in the plant of the Utica Gas & Electric Corp. at Trenton Falls, New York, is shown

PROGRESSIVE STAGES SHOW METHOD OF BUILDING UP THE PITTED AREAS OF THE RUNNER WITH MONEL METAL

in the photograph. The wheel in this case is of cast iron and belongs to an 8000-kw. generating unit. Before welding the pitted parts are chipped out to insure a sound and clean base for the built-up metal. Because of its relatively high ductility and high resistance to corrosion, monel metal is used. Contraction strains are taken care of nicely by this metal without cracking either the weld or the cast-iron runner. No preheating or annealing is required as the welding is done slowly to avoid local expansion and contraction.

On the wheel shown the bucket in the left-hand side has been filled in with monel metal while the two in the immediate foreground show the extent of the pitting and the area chipped out with the air hammer preparatory to welding.

Before proceeding with this particular job, the Utica Gas & Electric Corporation's engineers examined a repair job on one of their other wheels which had been in service for 3 yr. On inspection this job was found to be in perfect condition with no evidence of corrosion, pitting or electrolytic action and indicates the reliance which may be placed on the electric arc welding process.

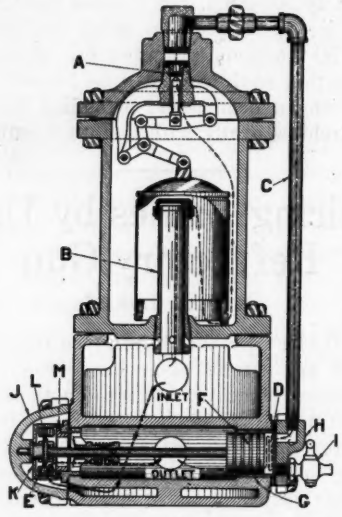
In a test as to best intensity of lighting, the Public Health Service has found that for work of the character of mail sorting 8 candle-feet is productive of greatest output and, allowing for some deterioration, 10 candle-feet is suggested as a standard provision. It was found, also, that natural illumination apparently causes less eye defects than artificial.

*Vice-President, Lincoln Electric Co., Cleveland, Ohio.

New Armstrong Compound Trap

IN RESPONSE to the demand for a large capacity high-pressure trap, the Armstrong Machine Works, Three Rivers, Mich., has developed a compound trap designed to handle sudden large inflows of condensate under high-pressure as well as low-pressure conditions. This new trap incorporates the inverted submerged bucket principle and has, in addition, a piston actuated valve designed to enable the trap to discharge large quantities of water rapidly.

Operation of the trap can be understood by reference to the accompanying sketch. Assuming that the upper part of the trap, except the inverted bucket, is full of water, the bucket will be full of steam and will float, holding the valve A closed. This valve will remain closed as long as steam is flowing up through tube B. Water accumulates in the base until the bottom of tube B is submerged, stopping the steam flow into the bucket. The bucket then sinks, opening valve A and discharging through A down pipe C into cylinder D, as indicated. The pressure on piston F opens valve E against the



SECTION THROUGH NEW COMPOUND TRAP SHOWING FLOW OF STEAM AND CONDENSATE

pressure of the spring and direct discharge takes place through valve E, as shown by the heavy dotted lines.

When the discharge has lowered the level in the base until the bottom of tube B is uncovered, steam again flows into the bucket, buoys it up and the bucket rises to close valve A. While A is open there is a constant flow through a small vent in piston F. This vent allows the pressure to be released when valve A is closed and permits the spring on valve E, aided by the pressure of the water, to close E as soon as the flow has stopped. It is seen that the trap is designed to discharge as long as water comes to it. If the flow is very small, it may be handled entirely through valve A.

The trap is carefully constructed and tested, all upper valve and piston parts being of heat treated chrome steel and the cap, body and base being of high tensile cast iron. It is designed for the draining of purifiers, sprays, drip headers and similar apparatus needing a large capacity high-pressure trap.

Mycalex, a New Insulating Material

ACCORDING TO an announcement from the General Electric Co., a new type of insulating material has been developed which not only solves the problem of an improved insulator for high frequency currents such as are encountered in radio work, but also solves the problem in more efficient utilization of materials. The new insulation, known as Mycalex, is a composition of brown mica and lead borate. Mica previously presented a difficult problem because of the enormous waste. Obtained in Canada and India in large sheets, there was considerable waste at the mines; it was estimated that only five per cent of the material taken from the mines could be used. In manufacturing there were further wastes of the small pieces of mica. But some years ago, it was found that these mica plates, mixed with a binding material and compressed under heat, made exceedingly good insulation. Sheets of prepared mica are used by the General Electric Co. in many manufacturing processes. Now a product has been developed which utilizes mica particles so that even more of the mineral is used.

It is claimed that the new material has better insulating properties than has porcelain and several applications for it have already been developed. The substance, light gray in color and with a metallic ring, is being used in the manufacture of bases for radio transmitter tubes, for insulators in high frequency work, and for numerous similar applications. Chief among its characteristics are that the metal part may be inserted or combined with Mycalex during the process of molding, and although a hard and stone-like product, it can be subjected to ordinary machining methods.

It has been recommended for use where the requirements demand an insulating material of high mechanical strength, dielectric strength, and insulating resistance, low losses with high frequency, heat resistance beyond the ordinary range of molded or sheet materials, and compact construction with metal inserts securely molded in place.

HYDRO-ELECTRIC power developed in connection with irrigation projects is stated by the Bureau of Reclamation to have lessened construction and operation costs as well as improving conditions on the farms of these projects. Development of the power would have been unprofitable without the irrigation project but use of the power for drag-line excavators in building and cleaning out canals, for pumping water and for electric light and power on the farms has proved a great gain, the revenue from the power plants keeping down charges for irrigation and lowering of construction costs paying for the cost of the plant in some cases.

Low rates are made for current, since none of the cost of the dam is charged against the power plant and settlers find that electric power, at these rates, is cheaper than gasoline or kerosene.

At Yuma, the cost of the power plant was $320,000 and net yearly revenue is estimated at $50,000. Total investment in 13 reclamation power works is given as $6,077,549 and gross earnings for 1925 as $1,067,135 with net earnings $442,619, about 7 per cent on the investment in power plant.

Health of Workers Aids Prosperity

BY H. L. WILLIAMS

NO BETTER provision can be made for a long and prosperous life than disease prevention by means of good working and living conditions, proper food, healthful rest and diversions. Sunshine and light in the factory or plant are good for worker as well as employer for they promote effectiveness and cheerfulness.

Listed among important factors in preserving and increasing health and efficiency, in his book Health and Workman, Dr. Lee K. Frankel gives ventilation, lighting, protection against dust and poisons, adequate washroom and toilet facilities and plenty of pure, cool drinking water.

Daylight is best but, whether that or artificial light is used, glare should be avoided and electric bulbs shaded to prevent direct rays reaching the eyes.

Hot and cold water, facilities for washing hands frequently and paper towels or individual towels are preventives against passing of germs and spread of disease. Dressing and locker rooms so that work clothes may be removed before meals and at the end of the day keep dust and dirt from being swallowed or carried home to the families.

Tuberculosis killed some 50,000 workers last year in the United States, many of whom might have been saved by better living and working conditions and by care of the Workman, Dr. Lee K. Frankel gives ventilation, lighting, protection against dust and poisons, adequate washroom and toilet facilities and plenty of pure, cool drinking water.

Proper food depends upon the occupation but one who includes plenty of green vegetables and milk and only a moderate amount of meat is not likely to be wrong. Oversupply of starchy foods such as rice, potatoes and spaghetti is to be avoided. Variety is essential to good health as well as good appetite.

Finally refreshing sleep, 8 hr. on the average, and daily diversion, which is well removed in character from the daily occupation, are important for non-working hours.

National, state and local tuberculosis associations advocate strong bodies as the best preventive of disease and are waging a continuous campaign with this end in view. Their work is financed by the sale of Christmas seals throughout the country in December. This year the seals show "The Carolers" of olden time. They will carry your greeting of cheer to friends and correspondents and, by buying and using them you will share in the campaign for health and prosperity of workers.

PREVENTION and removal of boiler scale by means of an emulsion from passing steam through linseed oil, condensing the product and thus getting the constituents of the oil which are soluble in water is a method now used on a considerable scale in England. It is described in Engineering of London. The oil chamber is cooled by a water jacket to produce condensation of the steam and the resulting emulsion is fed to the hot well or feed tank through a thermostatic trap which will pass the emulsion but not steam.

A.S.M.E. Announces Annual Meeting Program

AT THE annual meeting of the American Society of Mechanical Engineers to be held in New York City, December 6 to 9, many papers of unusual interest to men in the power plant field appear on the program. Those which deal directly with power plant problems are listed below:

Tuesday Morning, December 7, 9:30 a.m.

Relations of Stokers to Boilers, W. A. Shoudy.
Allocation of Boiler and Power Costs to Heat and Power, W. R. Herod

Tuesday Afternoon, December 7, 2:00 p.m.

Effect of Smoke on Health, Dr. W. C. White
Smoke Abatement, H. B. Meller
Present Status of the Smoke Problem, Osborn Monnett
Status of Heat Transmission Data and Knowledge in the Refractory Field, P. Nicholls
Determination of the Thermal Conductivities of Heat Insulation for Temperatures Up to 1000 Deg. F. on Other Than Flat Surfaces, R. H. Heilman
Heat Transmission from Condensing Steam to Water in Surface Condensers and Feed Water Heaters, W. H. McAdams, T. K. Sherwood, and R. L. Turner
Heat Transfer for Forced Flow of Air at Right Angles to Cylinders, W. L. Chappell and W. H. McAdams
Methods That Have Been and Are Being Used for Measuring Heat Transmission, F. G. Hechler
Measurement of Static Pressure, Carl J. Fechheimer
On the Lubrication of Waste Packed Bearings, G. B. Karelitz
Latest Discoveries in Chemistry of Coal, Dr. Cecil Howard Lander, Director, Fuel Research, Department of Scientific and Industrial Research, London, England

Tuesday Evening, December 7

Low Temperature Carbonization of Coal, A. C. Fieldner
The Distillation of Coal, W. H. Blauvelt
Complete Gasification of Bituminous Coal, R. S. McBride
Industrial Applications of Conveyor Systems, C. A. Burton
Stresses and Deflections in Large Dynamo Frames Due to Dead Load, M. Stone

Wednesday Afternoon, December 8

Steam Tables Research
Educational Training for Industry, Matthew Woll
Trades Training, Carl S. Coler

Wednesday Evening, December 8

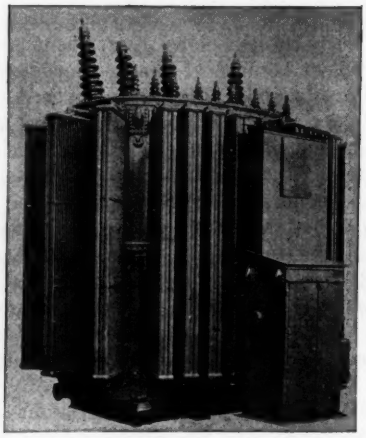
The Influence of Radiation in Coal Field Furnaces on Boiler Requirements and a Simplified Method for Its Calculation, W. J. Wohlenberg and E. L. Lindseth
Operation Performance Modern Surface Condensers, Paul A. Bancel
Some Results of Condenser Operation, Edwin B. Ricketts

Thursday Afternoon, December 9, 2:00 p.m.

Two Cycle Oil Engines, E. C. Madgeburger
Ideal Gas Engine Cycles, R. C. H. Heck
The Tangent Method of Analysis for Indicator Cards of Internal Combustion Engines, P. H. Schweitzer
The Boiler House in Oil Refineries, H. A. Ross

Boston Company Installs Large Transformers

WHAT ARE CLAIMED by the makers to be the world's largest self-cooled transformers were recently shipped to the Edison Electric Illuminating Co. of Boston from the Sharon Works of the Westinghouse



ONE OF THE 25,000-KV.A. TRANSFORMERS INSTALLED AT BOSTON

Electric and Manufacturing Co. There were two of these transformers, each rated 25,000 kv.a., 3-phase, 120,000 v. Each transformer weighs 120 t., including the oil, and is so large that it was necessary to divide the tank into two parts to get it within railway clearances. The transformer proper, that is windings and iron, were shipped in oil in a separate shipping tank. The radiators were removed from the tank and shipped separately. Each transformer, therefore, required four standard cars to transport it.

Japan Invites International Engineers to Conference

AT A LUNCHEON held on October 20 at the Engineers' Club in New York City, Dr. Kamo, who is serving his second term as president of the Society of Mechanical Engineers in Japan, extended a formal invitation from Japan to the engineers of America to participate in an engineering conference to be held in Japan in the fall of 1929. In anticipation of the receipt of formal individual invitations, all engineering societies are encouraged to take such action as will lead to the fullest possible participation in this unique event.

This conference has the backing of the Japanese government and has been taken up in a similar manner in the United States through discussions between officers of the following engineering societies: American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, and The Society of Naval Architects and Marine Engineers.

News Notes

PENNSYLVANIA PUMP & COMPRESSOR CO. announces the appointment of Lee & Clark, 549 Washington Blvd., Chicago, as representatives in the Chicago district.

ALLIS-CHALMERS MANUFACTURING CO. has recently opened a branch office in the Reynolds Bldg., Jackson, Mich., with L. F. Berry as representative.

GEORGE E. TEEL, for many years manager of the Salem Electric Lighting Co., Salem, Mass., died at his home in that city Oct. 13. He had been with that company since 1888.

MONTPELIER & BARRE (Vt.) Light & Power Co. is to be sold by the Charles H. Tenney interests to others, according to negotiations under way by which stockholders may deposit their stock with the voting trustees until Jan. 15, 1927.

THE MOUNTAIN MILL PAPER CO., East Lee, Mass., has taken over the hydro-electric plant of the Tayford Co., Inc., at East Lee and contracts have been let to connect the power plant with the Mountain Mill plant. The Tayford plant cost between $150,000 and $200,000 to build. It supplies current to the town as well as the industries.

ANNOUNCEMENT IS MADE of the formation of Robert J. Anderson, Inc., to operate as a commercial testing laboratory, specializing in metals and alloys. The new laboratory, located at 2416-38 Beekman St., Cincinnati, O., is staffed by a corps of qualified chemists and metallurgists under the direction of Robert J. Anderson, who is also president of the company.

THE PUBLIC UTILITIES COMMISSION of Massachusetts has heard petitioners of the Worcester Electric Light Co. and the Worcester Gas Light Co. to consolidate and is expected to report a decision within a few weeks. There was no opposition to the petitions.

GEORGE O. SPENSER of Middlebury, Vt., representing the Insull interests of Chicago, has purchased the Hortonia Power Co., operating plants and power lines in Mansville and Port Henry, N. Y., two at Middlebury, Vt., two at Salisbury, Vt., Gaynesville, Vt., and others in Vermont and New Hampshire.

FRANK W. REMICK, member of the banking firm of Keader, Peabody & Co., Boston, and director of the Mississippi River Power Co., Puget Sound Light & Power Co., and other corporations, died in Boston Oct. 16.

CENTRAL MAINE POWER CO., which is expanding its transmission lines, will have extended service to Islesboro, Friendship and Newcastle, Me., before winter sets in. A submarine cable has been laid from Castine to Islesboro and the entire island population will be supplied, including the large number of summer homes. In Friendship 75 houses are already wired in advance of the transmission lines.

CHAIN BELT CO., Milwaukee, Wis., has started work on a new engineering building at its West Milwaukee works. This building will house the steel fabricating and assembly departments, drafting room and general engineering offices of the contract division of its business. When this, the third unit to be erected on the West Milwaukee site, is completed approximately half of the organization will be located at these works. The building will be 308 ft. long by 120 ft. wide, with the exception of the office building, which will be 144 ft. wide. Frank B. Chase, Inc., Chicago, is in charge of the engineering and design work.

PLANS HAVE been perfected by the Southwestern Public Service Co. for the construction of a proposed new generating plant at Amarillo, Texas, to be carried out under the direction of the Day & Zimmerman Engineering & Construction Co. of Philadelphia, Pa. The station will consist of a one-story building, brick and steel type, with site allowing for later expansion as may be required. The initial installation will comprise two 836-hp. water-tube boilers, one 5000-kv.a. turbo-generator, one 8500-sq. ft. condenser, with accessory apparatus. The plant will be arranged to utilize gas as fuel. The entire project will cost close to $750,000. It is purposed to push the project to early completion. Extensions will be made in transmission lines to reach a number of additional communities throughout this district.

SOUTHERN CITIES POWER CO., Chattanooga, Tenn., has plans for the construction of two new steam-operated electric power plants to be located near Lewisburg and near Shelbyville, Tenn., respectively. The first noted will be located on the Duck River, about 10 mi. from Lewisburg, with initial structure 40 by 50 ft.; the other station will be situated about 6 mi. from Shelbyville, with two-story power house structure. The two plants are reported to cost in excess of $200,000, with machinery. Extensions will be made in transmission lines in this district to reach additional communities for commercial light and power service.

UNITED ELECTRIC LIGHT CO., Springfield, Mass. plans a new generating plant to cost in excess of $1,000,000. Plans of the structure are being prepared by Stone & Webster, Inc., Boston. While construction work will be ready to be pushed forward as soon as the plans are accepted, the company is at present withholding information as to details of the plant or its precise location in Springfield.

THE NORTH AMERICAN CO., Cleveland, Ohio, will complete its Big Meadow power dam on the Feather River, California, early in December, developing what is said to be the largest water power reservoir in the world. The water impounded is estimated to have a potential development of 1,000,000 hp., and will be utilized by the company for its hydro-electric power operations on the Feather River, including projects of this kind still to be constructed. The new reservoir will provide a storage capacity of more than 1,000,000 acre-ft., and will be fed by the 500-sq. mi. watershed of the company in this district.

WALTER S. WYMAN, president of the Central Maine Power Co., one of the Insull companies, predicts a 100,000-hp. development at Bingham, Me., and more than $1,000,000 in state taxes annually as a result of development already under way or under consideration in hydro-electric projects in the state. The Gulf Island power plant at Lewiston is nearing completion. The dam was not scheduled to be completed until the middle of January but work progressed so favorably that it is

now complete. If permission is given to send power out of the state by the legislature, Mr. Wyman says construction would start at once on a 100,000-hp. development at Bingham by his company.

THE KENTUCKY HYDRO-ELECTRIC CO., a subsidiary of the Kentucky Utilities Co., same city, is perfecting plans for the construction of a hydro-electric generating plant on the Kentucky River, about 3 mi. from its Dix River Dam station. Work on the new plant is slated to begin early in the spring; it is expected to develop an output of about 10,000,000 kw-hr. per annum at the station, and orders for equipment, it is said, will soon be let. New transmission lines will be built. The parent company is disposing of a bond issue of $6,250,000, a considerable portion of the fund to be used for the development.

BOTFIELD REFRACTORIES CO., Philadelphia, Pa., announces the appointment of four new distributors throughout the country: The Westwater Supply Co., 150 No. Third St., Columbus Ohio; The Klinger-Dills Co., 129-131 No. Jefferson St., Dayton, Ohio; Coan Equipment Co., 236-242 Murray St., Fort Wayne, Ind.; and Cleveland Tool & Supply Co., 1427 West Sixth St., Cleveland, Ohio.

THE TURNERS FALLS POWER CO., Turners Falls, Mass., has completed the $150,000 high tension line for the Holyoke Water Power Co. Cost of construction was above $15,000 per mile. Seven wires, six of them power wires, were strung to carry the 66,000 v., requiring 35 mi. of wire.

THE TEXAS CENTRAL POWER CO., San Antonio, Tex., is planning the erection of a new 1-story ice making plant at Bay City, Tex., and a 1-story addition to the existing ice plant at Crystal City, Tex. Each project is to cost about $30,000.

Catalog Notes

FOSTER SUPERHEATERS for marine boilers are described in catalog MS-5 issued by Power Specialty Co., New York City.

METROPOLITAN INJECTORS in various types, sizes and capacities are described in a 65-page booklet issued by The Hayden & Derby Mfg. Co., Boston, Mass.

BETHLEHEM STEEL CO., Bethlehem, Pa., in booklet No. 113, just issued, discusses the composition, method of working and applications of its stainless steel and stainless iron.

J. E. LONERGAN CO., Philadelphia, Pa., in its new catalog No. 300, describes and illustrates its complete line of steam specialties. These include safety and relief valves, all types of pressure gages and gage cocks, oil cups and other lubricating devices, various types of whistles and water gages.

ILLINOIS ENGINEERING CO., Chicago, Ill., has recently issued bulletin No. 22, which is descriptive of the Illinois heating systems and vapor specialties manufactured by this company. This book contains a great deal of engineering information relative to the installation of heating systems for various types of office and residential buildings. It also gives standards for computing radiation and boiler sizes compiled by the Standardization Committee of the Chicago Master Steamfitters' Association.

WM. W. NUGENT & CO., INC., Chicago, Ill., has just issued bulletin No. 0 describing its lubricating devices and accessories.

AMERICAN MODEL K SHOVEL, designed for gasoline, steam or electric operation and adaptable to log handling, clamshell and general crane work, is described in the new and attractively illustrated 16-page bulletin issued by American Hoist & Derrick Co., St. Paul, Minn.

CLIMAX ENGINEERING CO., Clinton, Ia., is distributing a revised edition of its booklet entitled "Lubrication Instructions for Climax Trustworthy Engines." This book was prepared in collaboration with the technical staff of the Vacuum Oil Co. It contains many valuable data on the lubrication of Climax engines. Copies will be sent upon request.

BACHARACH ELECTRIC CO. meters for carburetor adjustment of high-speed internal combustion engines are described in bulletin No. 253 recently issued by Bacharach Industrial Instrument Co., Pittsburgh, Pa. The bulletin is a treatise on the value of gas analysis as a guide to the efficient operation of internal combustion engines and points to the importance of carburetor adjustment by gas analysis.

THE HAYS CORP., Michigan City, Ind., has just issued an 8-page folder describing and illustrating Hays pointer gages for draft, pressure and differentials. These gages utilize the action of a leather diaphragm and a cantilever spring, the latter being directly connected to the pointer of the instrument. They are designed to have a permanent zero setting and to eliminate the use of dashpots for dampers. They can be secured in either the edgewise type or the flat type.

BINKS SPRAY EQUIPMENT CO., Chicago, Ill., has just issued bulletin 4-E describing and attractively illustrating its spray cooling systems for condensing and circulating water. Data are given on water ratios, nozzle capacities and sizes, details of spray heads, arrangement of spray ponds and similar details. Many interesting photographs of typical installations are also shown. Copies of the bulletin may be obtained from the company.

THE FLORIDA PUBLIC SERVICE CO., Orlando, Fla., is distributing to stockholders and others an attractive booklet published incidental to the putting in operation of the company's new Benson Springs power station. The booklet tells in detail of the growth of the company and emphasizes the importance to the central Florida district of a modern public utility service. Benson Springs power station, located on Lake Monroe, opposite Sanford, Fla., was erected and started in a record time of 7 mo. It is one of the first large central stations in Florida, with an initial installation of 12,500 kw. capacity, to which other units will be added as the demand for power increases. The company has purchased several municipally-owned electric plants and distribution systems and has under way an extensive program of interconnection and improvement. The W. S. Barstow Management Association, Inc., are operating managers of the company.

Sparks from the Advertising Pages

Where Buyers and Sellers Meet

To Make Your Buying Better

Fifty million horsepower now installed in the United States not only makes this country the largest power-using country in the world, but also entails upon the engineers of power plants a tremendous responsibility in recommending and purchasing for the plants that generate the power.

It seems evident, from U. S. Census reports, that the buying of machinery, equipment and supplies, not including coal, buildings, real estate or anything outside the plant, may be estimated as below:

For renewals and replacements on 50,000,000 hp. now installed....	$1,100,000,000
For supplies, other than coal, for 50,000,000 hp.	40,000,000
For machinery and equipment for 1,483,200 hp. of new construction	325,304,000
Total buying for 1927.....	$1,465,304,000

Here is close to a billion and a half dollars' worth of equipment that engineers will buy from manufacturers.

Who will buy and who will sell will shape the future of plants, determine the authority and consequent remuneration of engineers, and bring prosperity to certain manufacturers and perhaps become the turning point in their business.

The improvement of a piece of equipment requires not only inventive genius but countless tests, changes and experimentation to make it practical, fool proof, and finally marketable.

If the engineer understands such perfected equipment and is willing to see its advantages and to break away from tradition to adopt it he stands higher in his organization, his plant shows a more economical record, and there is a further gain in his favor that will develop later.

By the orders of his patrons the manufacturer will have substantial proof of the value of his product. And with such favorable encouragement comes the means to further service in the field.

Not a manufacturer in the field but is constantly on the lookout for ways in which to continue to improve his products. And the swing of the great power plant market determines whether opportunities for improvements will be open to him.

Many engineers have failed to meet the critical opportunities of their life work because of their inability to put over their desire for improvements at a time when they alone recognize their importance.

Many an excellent product has failed to go over with engineers because its excellence was not recognized by them.

Swiftly and with exactitude the invisible trend of engineering favor swings the orders for a product, or lets it sink into oblivion.

Reliable manufacturers have long recognized these facts. Leading engineers know them. And both believe in giving careful attention to advertising as the means to advancement, prosperity and progress.

Never was there so much equipment to be purchased, never such careful consideration of its fitness to serve under the conditions in which it is to operate, as right now.

Nor was the time ever so favorable as now to benefit by a careful study of advertising.

The advertising in these pages is carefully prepared to help you in your buying, to assist you in obtaining better machinery, equipment and supplies and to insure better results from them.

In keeping with the improvement of their equipment, manufacturers are improving their service to you.

Machinery, Equipment and Supplies Used In The Production and Transmission of Power

Under the heading of each product listed will be found the names of the manufacturers of that product. The index to advertisers, next to the back cover, gives the page numbers on which the manufacturers' descriptive advertisements appear.

AIR COMPRESSORS
Allen & Billmyre Co., Inc., New York.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Bethlehem Shipbuilding Corp., Bethlehem, Pa.
Dean Bros. Co., Indianapolis.
De Laval Steam Turbine Co., Trenton, N. J.
Gardner Governor Co., The, Quincy, Ill.
Ingersoll-Rand Co., New York.
Murray Iron Works Co., Burlington, Iowa.
Nordberg Mfg. Co., Milwaukee.
Worthington Pump & Machinery Corp., New York, N. Y.
Yeomans Bros. Co., Chicago.

AIR FILTERS
Allen & Billmyre Co., Inc., New York.
Cooling Tower Co., Inc., The, New York.

AIR WASHERS.
Buffalo Forge Co., Buffalo, N. Y.
Cooling Tower Co., Inc., The, New York.
New York Blower Co., Chicago.

ALARMS, HIGH AND LOW WATER.
Hills-McCanna Co., Chicago.
Huyette Co., Inc., The Paul B., Philadelphia.
Northern Equipment Co., Erie.
Wright-Austin Co., Detroit.

ARCHES, BOILER AND COMBUSTION.
Betson Plastic Fire Brick Co., Inc., Rome, N. Y.
Brady Conveyors Corp., Chicago.
Burke Engineering Co., Holland, Mich.
Detrick Co., M. H., Chicago.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Hoftt Co., The M. A., Indianapolis, Ind.
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., The S., Chicago.
Plibrico Jointless Firebrick Co., Chicago, Ill.
Queen's Run Refractories Co., Inc., Lock Haven, Pa.
Quigley Furnace Specialtes Co., Inc., New York.
Walsh Fire Clay Products Co., St. Louis, Mo.

ASH BIN GATES AND DOORS.
Allen-Sherman-Hoff Co., The, Philadelphia, Pa.
Brady Conveyors Corp., Chicago.
Conveyors Corp. of Amer., Chicago.
Hagan Co., George J., Pittsburgh.

ASH HANDLING SYSTEMS.
Allen-Sherman-Hoff Co., The, Philadelphia, Pa.
Brady Conveyors Corp., Chicago.
Conveyors Corp. of America, Chicago, Ill.
Detrick Co., M. H., Chicago.
Hagan Co., George J., Pittsburgh.
Link-Belt Company, Chicago.
Stearns Conveyor Co., The, Cleveland, Ohio.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., The, Chicago.

ASH TANKS.
Conveyors Corp. of America, Chicago.
Hagan Co., George J., Pittsburgh.

BABBITT METAL.
Magnolia Metal Co., New York.

BAROMETERS.
Taylor Inst. Co.'s, Rochester, N. Y.

BEARING METAL.
Magnolia Metal Co., New York.
Strong, Carlisle & Hammond Co., Cleveland, Ohio.

BEARINGS.
National Tube Co., Pittsburgh.

BELT CONVEYORS.
Jeffrey Mfg. Co., The, Columbus, O.
Stearns Conveyor Co., The, Cleveland, Ohio.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., The, Chicago.

BELT DRESSING.
Dixon Crucible Co., Jos., Jersey City, N. J.
Standard Oil Co. (Indiana), Chicago, Ill.
Stephenson Mfg. Co., Albany.

BELTING.
Goodyear Tire & Rubber Co., Inc., The, Akron, O.
New York Belting & P'k'g Co., New York.
Quaker City Rubber Co., Philadelphia.
United States Rubber Co., New York, N. Y.

BELTING, SILENT CHAIN.
Link-Belt Co., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

BLOWERS, FAN & FURNACE.
Air Preheater Corp., The, New York.
Buffalo Forge Co., Buffalo, N. Y.
Coppus Engineering Corp., Worcester, Mass.
De Laval Steam Turbine Co., Trenton, N. J.
Ingersoll-Rand Co., New York.
New York Blower Co., Chicago.
Terry Steam Turbine Co., Hartford, Conn.
Wing Mfg. Co., L. J., New York.

BLOWERS, FORCED DRAFT.
New York Blower Co., Chicago.
Sturtevant Co., B. F., Hyde Park, Mass.

BLOWERS, PORTABLE.
Allen & Billmyre Co., Inc., New York.
Buffalo Steam Pump Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.
Marion Mach., Fdry. & Supply Co., Marion, Ind.
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis, Mo.
Vulcan Soot Cleaner Co., Du Bois, Pa.
Webster, Howard J., Philadelphia, Pa.

BLOWERS, PULVERIZED COAL.
Buffalo Forge Co., Buffalo, N. Y.

BLOWERS, STEAM.
Schutte & Koerting Co., Philadelphia.

BLOWERS, TUBE.
Bayer Co., The, St. Louis, Mo.
Marion Mach., Fdry. & Supply Co., Marion, Ind.

BLOWERS, TURBINE.
Allen & Billmyre Co., Inc., New York.
Moore Steam Turbine Corp., Wellsville, N. Y.
Wing Mfg. Co., L. J., New York.

BOILER BAFFLES.
Betson Plastic Fire Brick Co., Rome, N. Y.
Engineer Co., The, New York, N. Y.
McLeod & Henry Co., Troy, N. Y.
Quigley Furnace Specialties Co., Inc., New York.

BOILER CAP CLEANERS.
Lagonda Mfg. Co., Springfield, Ohio.

BOILER CASING.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.

BOILER COMPOUND.
Botfield Refractories Co., Philadelphia, Pa.
Dearborn Chemical Co., Chicago.
Hawk-Eye Compound Co., Blue Island, Ill.
McLeod & Henry Co., Troy, N. Y.
Paige & Jones Chemical Co., Inc., New York.

BOILER COMPOUND FEEDERS.
Hills-McCanna Co., Chicago, Ill.

BOILER COVERINGS.
Celite Products Co., New York.

BOILER FEED WATER, PURIFYING APPARATUS.
Griscom-Russell Co., New York.
Paige & Jones Chemical Co., Inc., New York.
Permutit Co., New York, N. Y.
Scaife & Sons Co., Wm. B., Pittsburgh.

BOILER FRONTS.
McLeod & Henry Co., Troy, N. Y.

BOILER MOUNTINGS.
Lunkenheimer Co., Cincinnati.

BOILER SEAM PROTECTORS.
National Boiler Protector Co., Dayton, Ohio.

To Find the Manufacturers' Advertisements of Products Listed Here, See Index Page 178

BOILER SETTING CEMENT.
Betson Plastic Fire Brick Co., Rome, N. Y.
Botfield Refractories Co., Philadelphia, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Huyette Co., Inc., The Paul B., Philadelphia.
Obermayer Co., The S., Chicago.
Plibrico Jointless Firebrick Co., Chicago, Ill.
Queen's Run Refractories Co., Inc., Lock Haven, Pa.
Quigley Furnace Specialties Co., Inc., New York.
Walsh Fire Clay Products Co., St. Louis, Mo.

BOILER SETTINGS.
Betson Plastic Fire Brick Co., Inc., Rome, N. Y.
Botfield Refractories Co., Philadelphia, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., The S., Chicago.
Plibrico Jointless Firebrick Co., Chicago, Ill.
Queen's Run Refractories Co., Inc., Lock Haven, Pa.
Quigley Furnace Specialties Co., Inc., New York.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Walsh Fire Clay Products Co., St. Louis, Mo.
Webster, Howard J., Philadelphia, Pa.

BOILER SKIMMERS.
Sims Co., The, Erie, Pa.

BOILER TUBE CLEANERS.
Lagonda Mfg. Co., Springfield, Ohio.
Liberty Mfg. Co., Pittsburgh.
Pierce Co., The Wm. B., Buffalo, N. Y.
Roto Co., The, Hartford, Conn.

BOILER TUBES.
Babcock & Wilcox Tube Co., The, Beaver Falls, Pa.
Bethlehem Steel Co., Inc., Bethlehem, Pa.
Murray Iron Works Co., Burlington, Iowa.
National Tube Co., Pittsburgh.
Reading Iron Co., Reading, Pa.
Scully Steel & Iron Co., Chicago.

BOILER WALL COATINGS.
Botfield Refractories Co., Philadelphia, Pa.
Celite Products Co., New York, N. Y.

BOILERS,
Ames Iron Works, Oswego, N. Y.
Babcock & Wilcox Co., N. Y.
Badenhausen Corp., Cornwells Heights, Pa.
Casey-Hedges Co., The, Chattanooga, Tenn.
Connelly Boiler Co., The D., Cleveland, O.
Edge Moor Iron Co., Edge Moor, Del.
Heine Boiler Co., St. Louis.
Kingsford Fdry. & Mach. Wks., Oswego, N. Y.
Murray Iron Works Co., Burlington, Iowa.
Nuway Boiler & Engineering Co., Chicago.
Springfield Boiler Co., Springfield, Ill.
Union Iron Wks., Erie, Pa.
Vilter Mfg. Co., Milwaukee.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn.
Webster, Howard J., Philadelphia, Pa.
Wickes Boiler Co., Saginaw.

BOOKS AND SCHOOLS.
McGraw-Hill Book Co., Inc., New York, N. Y.

BREECHINGS.
Littleford Bros., Cincinnati, O.

BRICKS, FURNACE LINING.
Celite Products Co., New York, N. Y.
Norton Co., Worcester, Mass.

BRUSHES, DYNAMO AND MOTOR.
Calebaugh Self-Lubricating Carbon Co., Inc., Philadelphia.
Dixon Crucible Co., Jos., Jersey City, N. J.

BRUSHES, GRAPHITE.
Dixon Crucible Co., Jos., Jersey City, N. J.

BRUSHES, WIRE.
Pilley Pkg. & Flue Brush Mfg. Co., St. Louis, Mo.

BUCKET ELEVATORS.
Jeffrey Mfg. Co., The, Columbus, O.
Link-Belt Company, Chicago.
Webster Mfg. Co., The, Chicago.

BUCKETS, COAL HANDLING
Jeffrey Mfg. Co., The, Columbus, O.

CAR DUMPERS.
Wellman-Seaver-Morgan Co., The, Cleveland, Ohio.

CARRIERS, PIVOTED BUCKET.
Jeffrey Mfg. Co., The, Columbus, O.
Webster Mfg. Co., The, Chicago.

CASTINGS.
Bethlehem Steel Co., Inc., Bethlehem, Pa.
Fuller-Lehigh Co., Fullerton, Pa.
Hills-McCanna Co., Chicago.
Neemes Fdry. Inc., Troy, N. Y.

CEMENT, ASBESTOS.
New York Belting & P'k'g. Co., New York.

CEMENT, FURNACE.
Betson Plastic Fire Brick Co., Rome, N. Y.
Botfield Refractories Co., Philadelphia, Pa.
Harbison-Walker Refractories Co., Pittsburgh.
McLeod & Henry Co., Troy, N. Y.
Norton Co., Worcester, Mass.
Plibrico Jointless Firebrick Co., Chicago, Ill.
Queen's Run Refractories Co., Inc., Lock Haven, Pa.
Quigley Furnace Specialties Co., Inc., New York.
Walsh Fire Clay Products Co., St. Louis, Mo.

CEMENT GUNS.
Cement-Gun Co., Inc., Allentown, Pa.